Computers in the Algebra Classroom

An Honors Thesis (HONRS 499)

by

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Abstract

Teachers are being urged to use computers in their classrooms, but often find they do not have the time to implement them into the allotted class time. This thesis is meant to give a teacher some concrete ways in which to use computers as a learning tool in their algebra classrooms without having to do a lot of their own research. The software discussed within - *Green Globs, Derive, Maple,* and *Interpreting Graphs* - can be very helpful to an algebra student. A short discussion of each package is followed by classroom suggestions for the use of the programs and some comments on the utilization of each.

Acknowledgements

I would like to express my sincere gratitude to a few people who were very gracious with their time and energies during the months that I worked on this project. First and foremost, Dr. Bernadette H. Perham, my advisor for this project, spent much of her own time helping me brainstorm for ideas, unlocking labs when they were closed, giving me permission to check out different equipment from the Mathematics Department, directing me to the places I needed to get information, donating much needed books and manuals for my use, and proofing my documentation. She was so very supportive and always boosted my spirits when I was afraid the project was getting out of my grasp. I will always be in debt to her. Not many people would undertake such an advisorship and do such a wonderful job.

I would also like to thank the Mathematics Department for allowing me to use their equipment and to check out items that were not normally checked out to students. In addition, Dr. Hubert J. Ludwig and Kay I. Meeks for loaning me their computer software and manuals for my use.

Lastly, I would like to thank my husband for understanding why I want my maiden name on this project and on my degree. But, I will always be known hereafter as Catherine S. Cullison and I am grateful for his love and support during this project and others.

Introduction

Computers have become a very intricate part of our everyday lives. We use them in business, industry, electronics, retail, service-oriented shops and even in our schools. But all too often, computers are avoided in education because they are seen to be too time-consuming - that there is too much material in the curriculum to be covered and that the computer time only takes away from instructional time. The computer games are commonly thought to be fun for the students, but steer them off task.

Computers can do more than run mindless games. That is nothing new to those who have worked with them. There are many software packages that can not only play games with the students, but actually teach the students as well. More importantly, it is fairly easy to supplement a lesson with a computer program. One area of mathematics that can benefit from this use of computers is algebra.

While there are countless computer software packages that can be used for algebra, there are a few that I found to be very valuable tools in the algebra classroom. These are - *Green Globs*, *Derive*, *Maple*, and *Interpreting Graphs*. This project will discuss each of these packages and offer some suggestions on classroom use. There are also sample activities that will help incorporate the software into the class curriculum. I have not given a tutorial for any of the software - it is up to you to go through the manual. But, I have given you a lot of basic information that I hope will be useful when deciding whether or not to look into these packages.

There is definite value to each piece of software included in this package. While you may only try a few of these programs or even only parts of the programs, I think that you will easily see the value of computers in the classroom. Feel free to copy any of the worksheets or use any of the ideas that are included in this packet for classroom use. Most of the worksheets and activities can be used with more than one program as long as the syntax is changed as needed. I hope that you and your students will benefit from it.

GREEN GLOBS

Green Globs from Sunburst Communication, Inc. is tailored to the classroom. It can be used on Apple, IBM PC, IBM PCjr, and on Tandy 1000. The program is broken down into four parts - *Equation Plotter, Linear and Quadratic Graphs, Green Globs*, and *Tracker*. The first two are exercises and the latter two are games that apply these exercises.

Equation Plotter

Use of *Equation Plotter* can begin in middle school as long as the students have a background in the coordinate grid and graphing of equations. When students enter an equation, *Equation Plotter* graphs it for them. The program will graph all of the following:

- linear equations
- trigonometric functions
- square root, absolute value, logarithmic, and exponential functions
- parabolas, circles, ellipses, and hyperbolas

as long as the equation is given as x in terms of y or as y in terms of x. It will even graph sums of these functions.

Using *Equation Plotter*, much of what is normally plotted on graph paper or on a chalkboard can be quickly and *accurately* presented on the computer screen. It can be used by the teacher on a large screen monitor for large group presentations or on the computer screen for work with smaller groups of students. Perhaps even more important is the hands-on activity opportunities it offers for students.

Equation Plotter is beneficial to the classroom because students can see the shapes of graphs and the relationship between the graphs and their equations (see Exercises). Students can easily make changes in the equations and notice how their manipulations to the equations affect their respective graphs. "What if" questions can easily be reviewed in this way.

Equation Plotter can be implemented throughout the semester. For example, each time a new type of function is introduced, *Equation Plotter* can be used by teacher and students for a better understanding of the function. Also, when factoring is discussed, *Equation Plotter* can be used to relate factoring to roots and for solving equations (see Exercise 8).

Comments on *Equation Plotter*

Equation Plotter is sometimes slow at graphing the requested equation. In particular, when asking it to graph more complicated equations or to sum graphs, the software takes some time to accomplish the task. However, it is still much quicker than graphing with a pencil and paper.

The worksheets that accompany the manual are very helpful. They are very useful at guiding the students. It is also very easy for the teacher to develop his or her own worksheets and activities. Some worksheets and activities are included that can be used in the classroom. *Equation Plotter* incorporates into a lesson easily. The usability of *Equation Plotter* is one of the reasons this program works so well in the classroom.

Equation Plotter is also a beneficial place to start with this software package. Practice with *Equation Plotter* and with *Linear and Quadratic Graphs* is essential for success in the games.

Activities and Worksheets for *Equation Plotter*

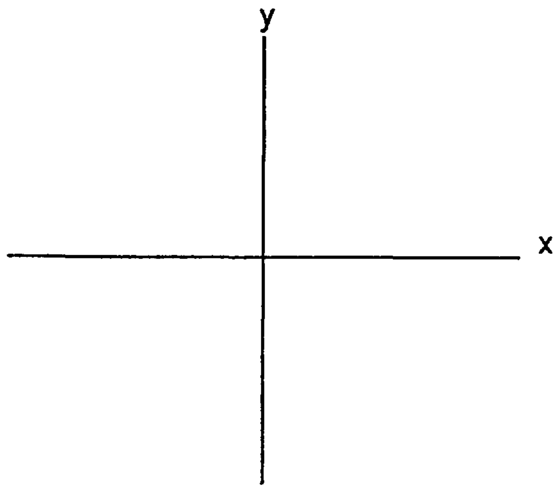
The following activities and worksheets can be implemented from time to time in your classroom. Most will easily supplement a lesson. For example, Exercise 3 has the students explain how the slope of an equation affects its graph. The emphasis is on slope and intercepts and would easily supplement a classroom discussion on these subjects. Other activities will lead them to discover things on their own. An example is Exercise 9. Students should be able to discover by the end of the activity that the number of factors is related to the power of the equation. This would benefit students in pairs or in groups of three so that students benefit from other students' ideas while still contributing their own.

Green Globs
Equation Plotter

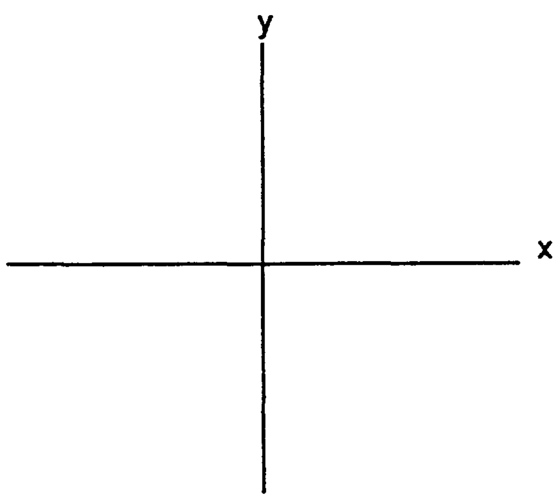
Exercise 1
Linear Equations

Using *Equation Plotter,* enter each of the following equations into the computer. Record each of the graphs that you see on the axes provided.

1. $x=5$
   $x=0$
   $x=-5$



2. $y=5$
   $y=0$
   $y=-5$



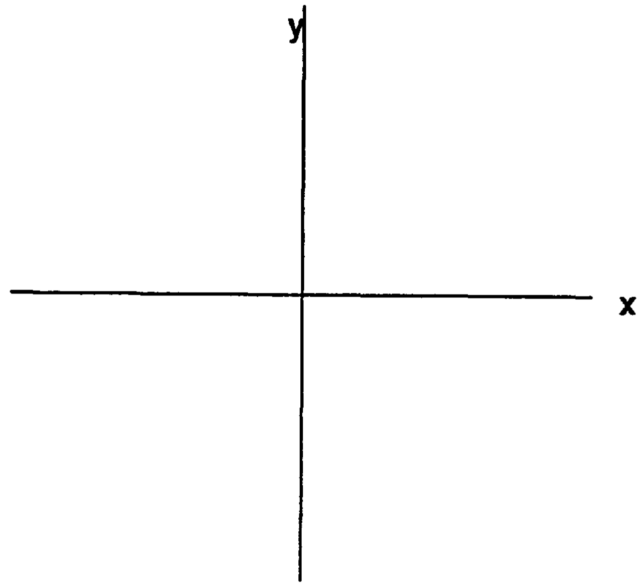
The graphs of the equations in #1 and in #2 look similar. In what ways are they similar and in what ways are they different?________________________________

____

____

____.

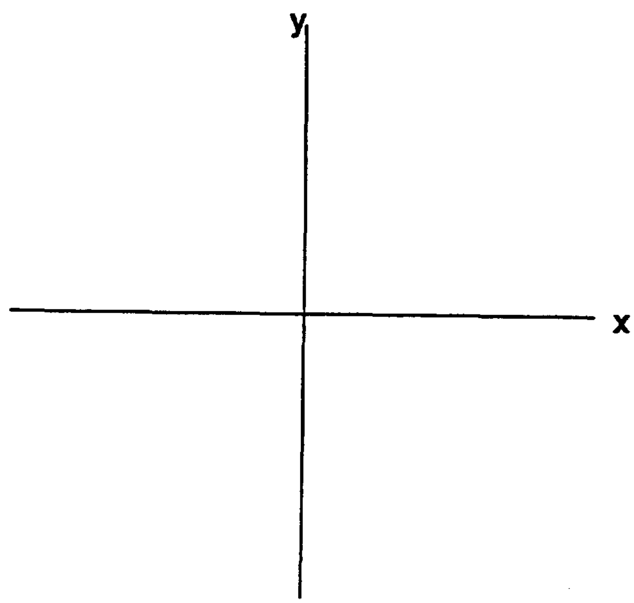
3. $y=2x$
   $y=2x+4$
   $y=-(1/2)x+4$



These equations look fairly similar. What do you think causes them to graph differently?

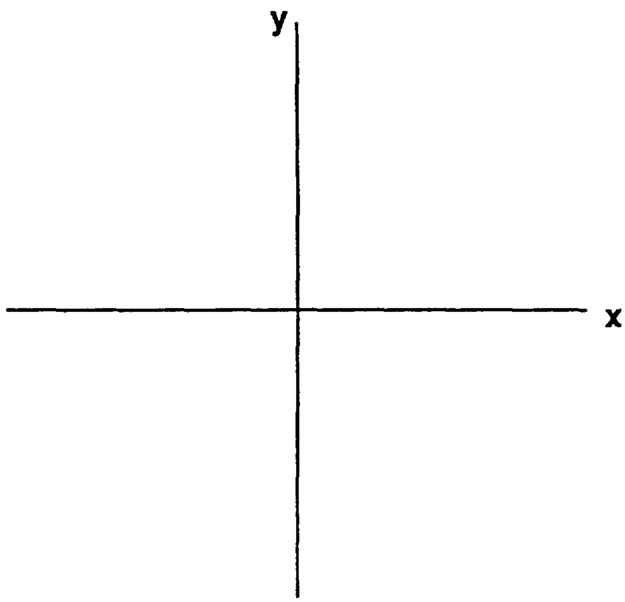
____
____
____
____.

4. $y=6x$
   $y=-6x$
   $y=-(1/6)x$



How does the slope affect the graphs of these equations? ______________
____
____
____.

5. $y=2x$
$y=2x+4$
$y=2x-4$



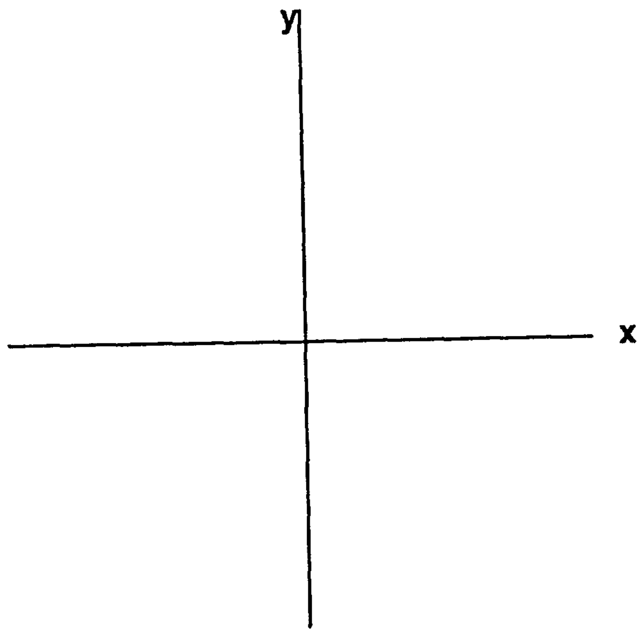
How do the y-intercepts affect the graphs of these equations?_______________

Green Globs
Equation Plotter

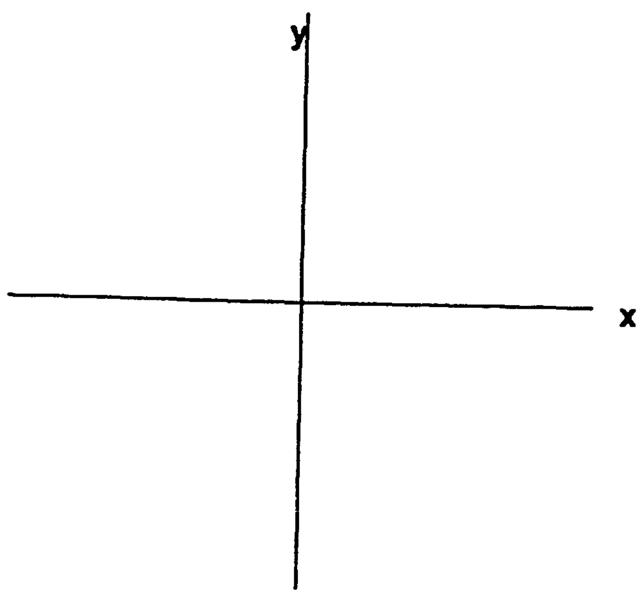
Exercise 1.5
More Linear Equations

Sketch the graph of each of the following equations and then check yourself using *Equation Plotter*. Record both graphs. Hint: Pay close attention to the slope and y-intercept value in each equation. Remember to put each equation into slope-intercept form for the computer. Do not worry about your sketch being exactly right. If your guess has the same slant and it crosses the axes at about the same place as the correct graph, you understand the significant parts of the equation.

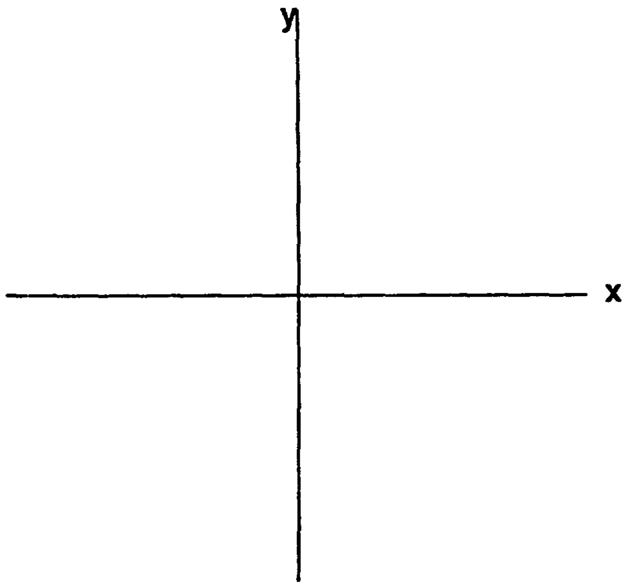
1. $2x-3y=6$



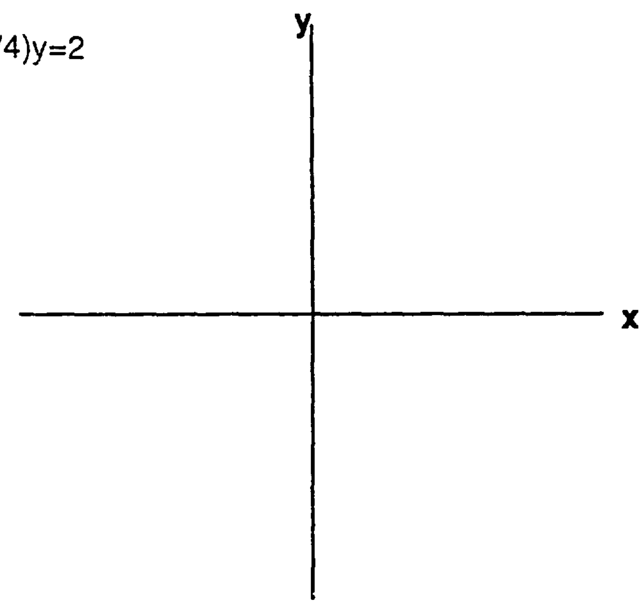
2. $5x-y=25$



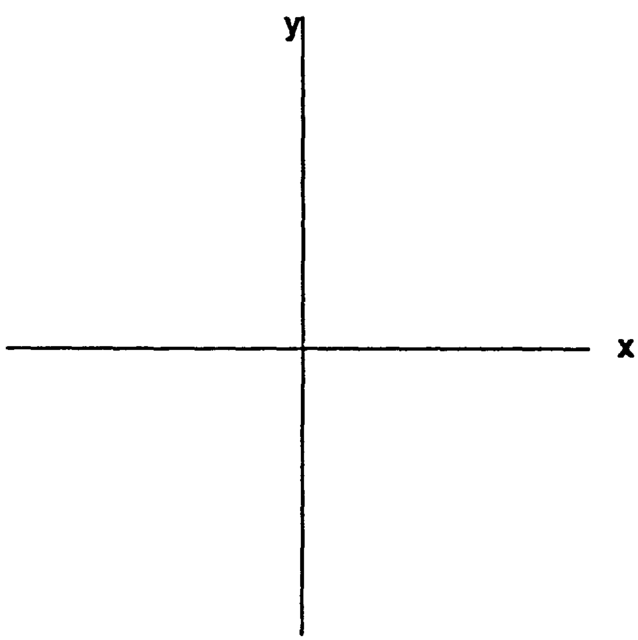
3. 4x-3y=12



4. (1/5)x + (1/4)y=2



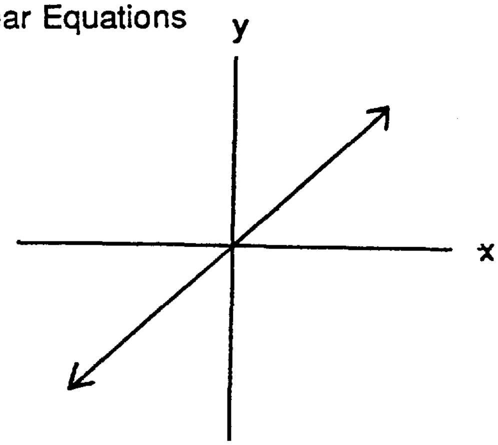
5. x-y=10



Green Globs
Equation Plotter

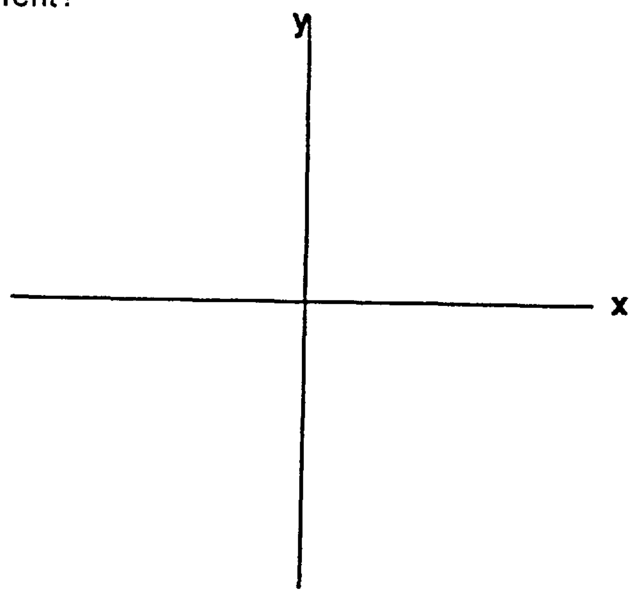
Exercise 2
More Linear Equations

The graph of y=x looks like this:

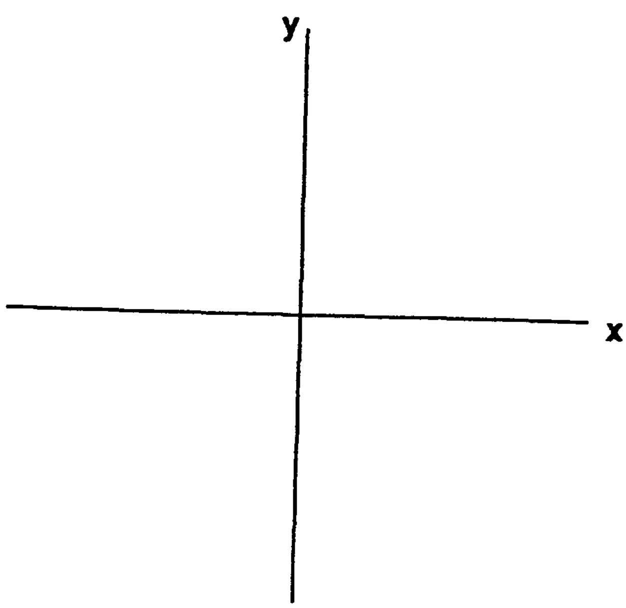


Using *Equation Plotter,* graph each of the following. Then record the graph on your paper. Explain how the graph is different from y=x. What parts of the equation cause it to be different?

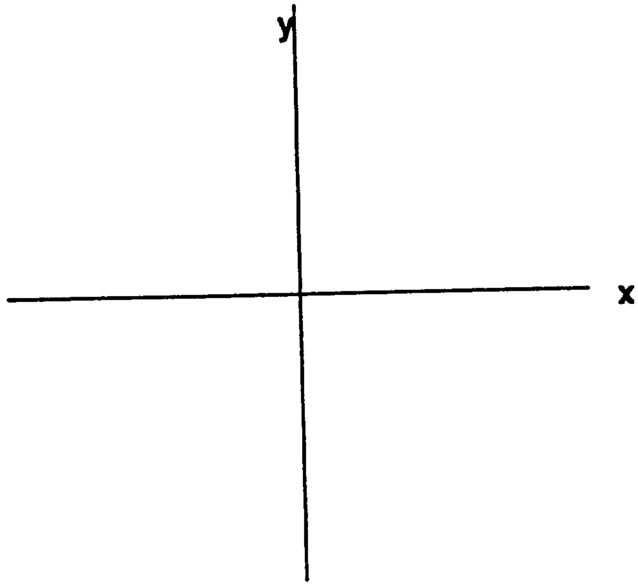
1. y=x+4



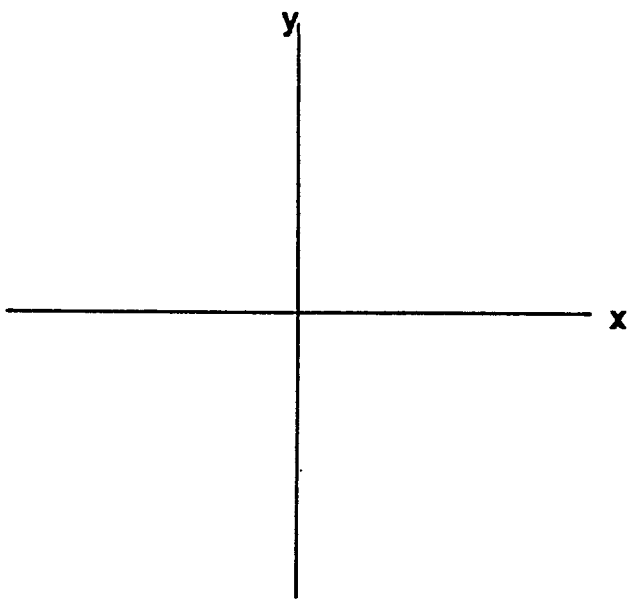
2. y=x-2



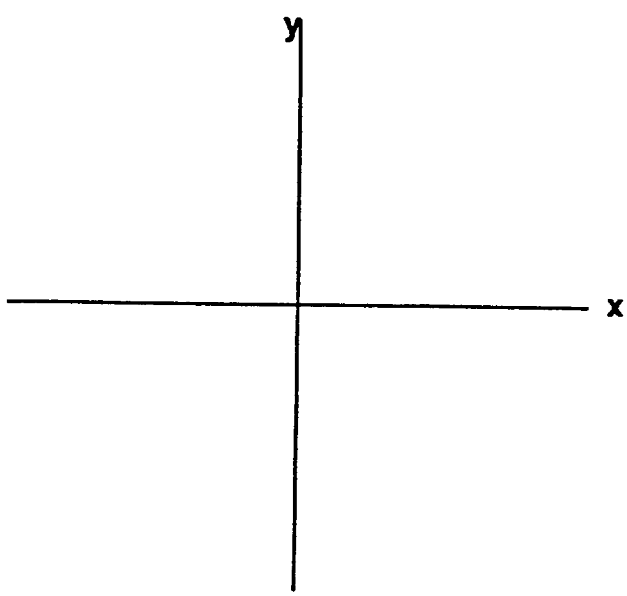
3. x-y=4



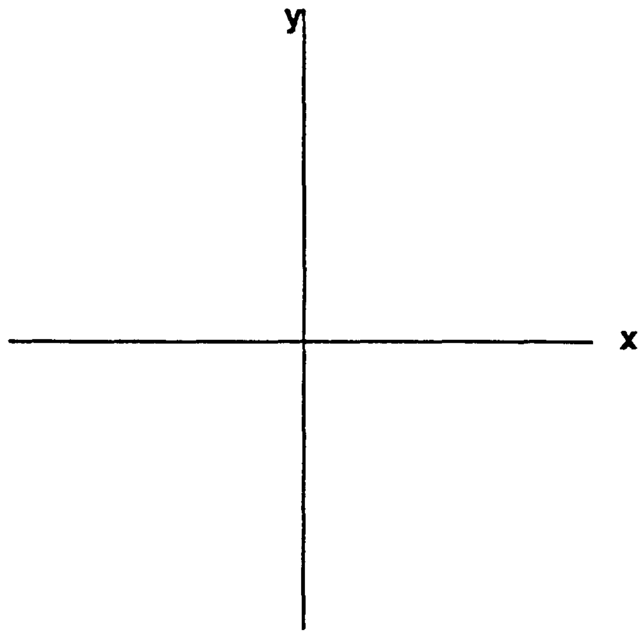
4. x-3y=4



5. 2x-3y=4



6. $2x-3y=-4$

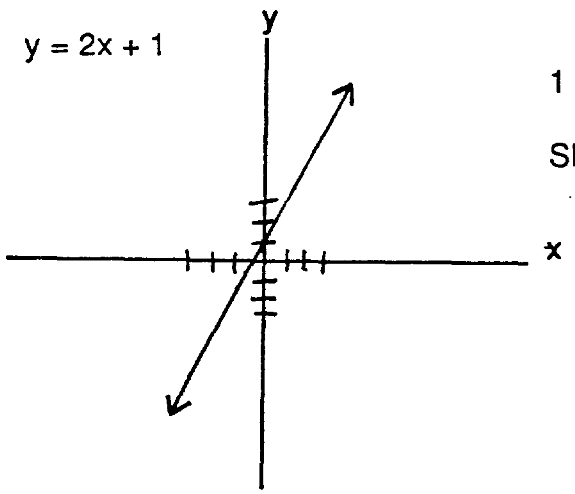


Green Globs
Equation Plotter

Exercise 3
Slope

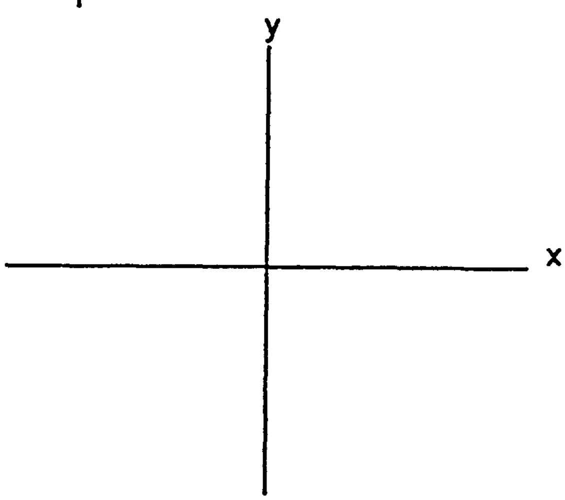
Record the slope of each of the following equations. Then graph each equation using *Equation Plotter*. Describe the slope of the line. What parts of the equation cause cause the graph to look this way?

Example: $y = 2x + 1$

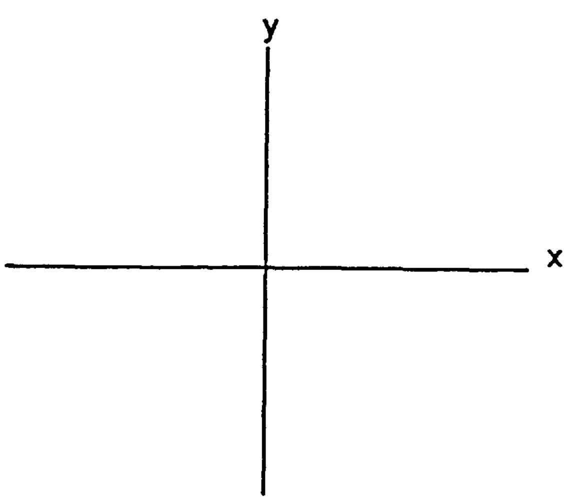


1 is the y-intercept. Thus, the graph intercepts the y-axis at 1.
Slope is +2, so rise/run = 2/1.
"up 2, over 1"

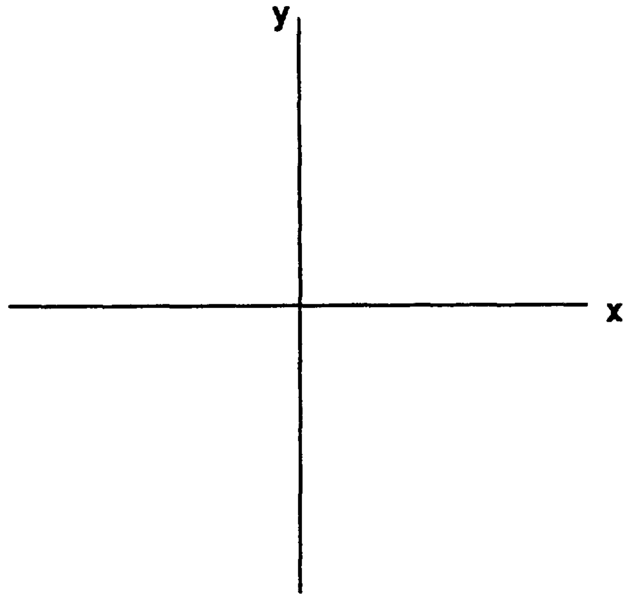
1. $y=2x+3$



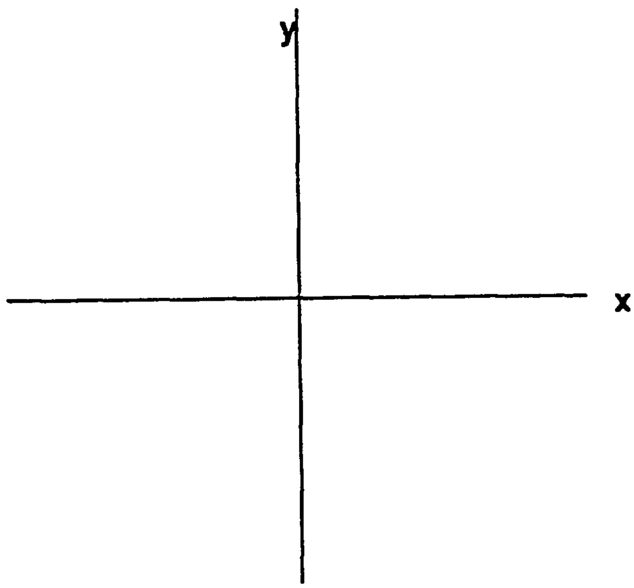
2. $y=3x-1$



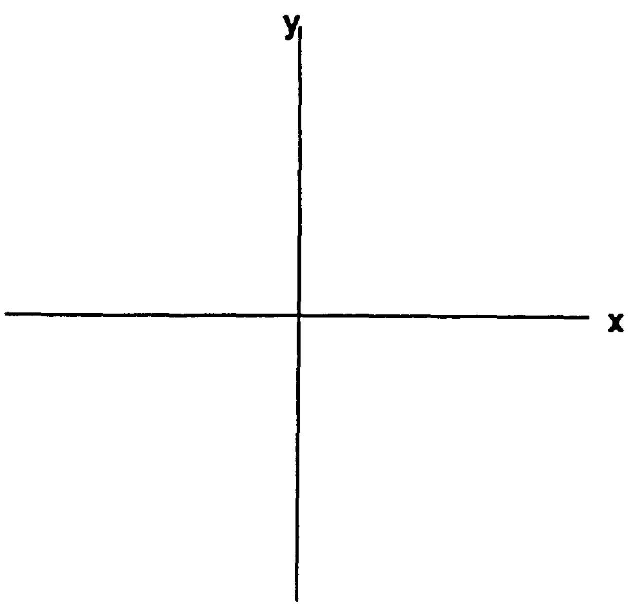
3. $y = -x+2$



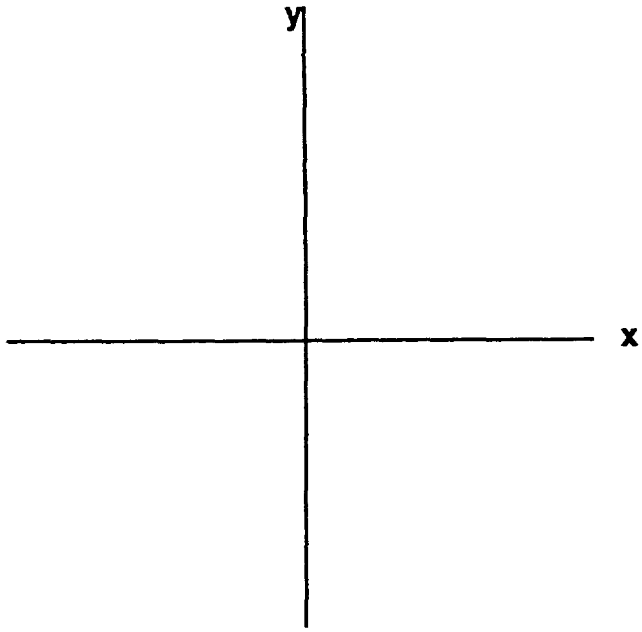
4. $y+2x=4$



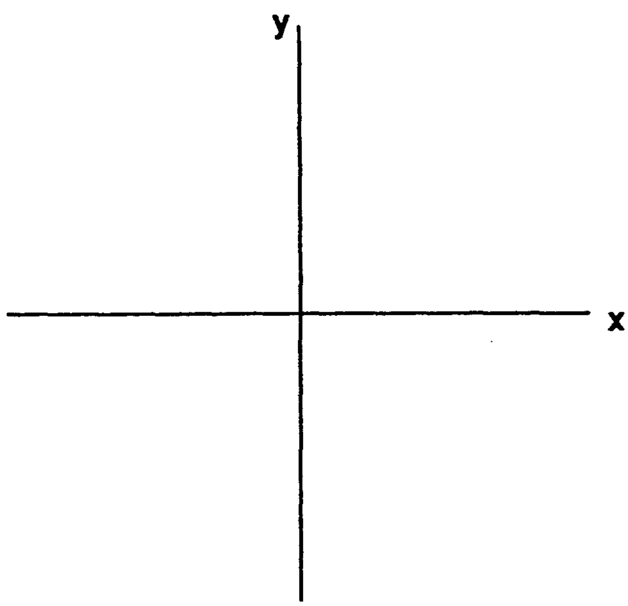
5. $y=0$



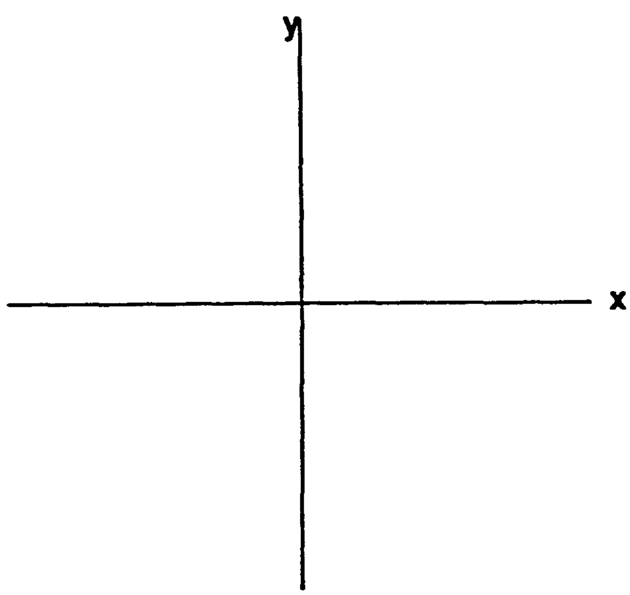
6. y=(1/2)x



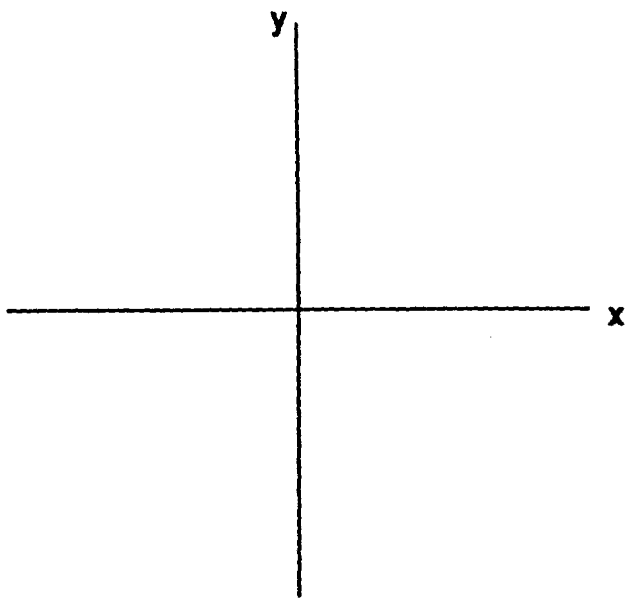
7. x-y+1=0



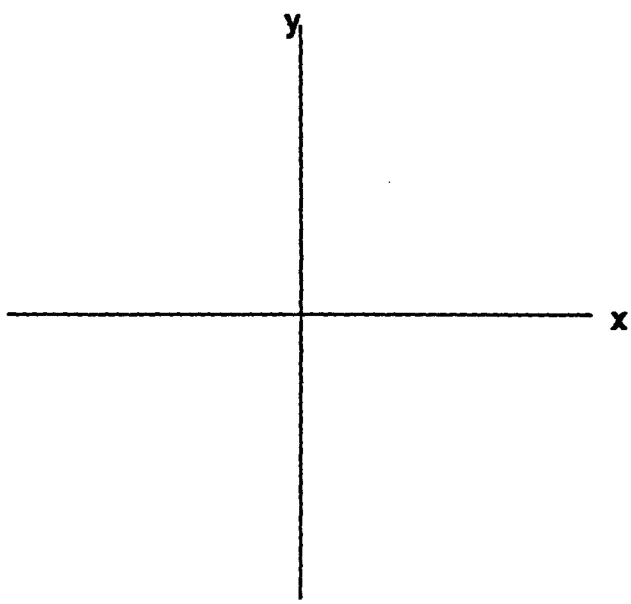
8. x=3y+2



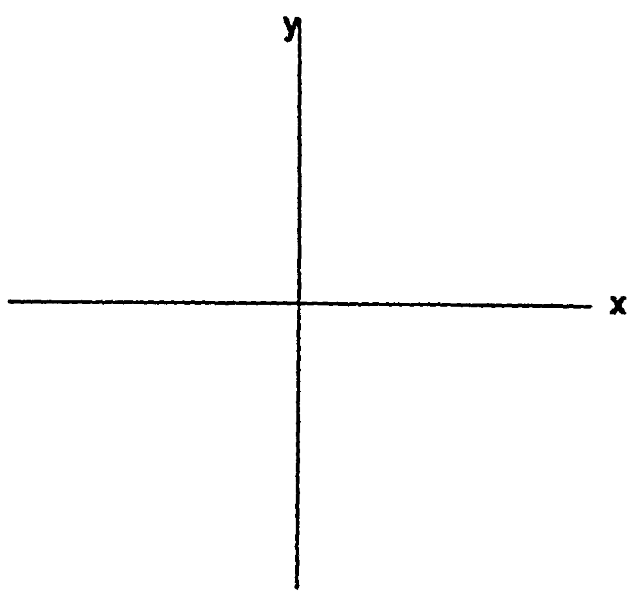
9. $(1/2)x+(1/3)y = 1$



10. $x+y=7$



11. $2x+4y=5$

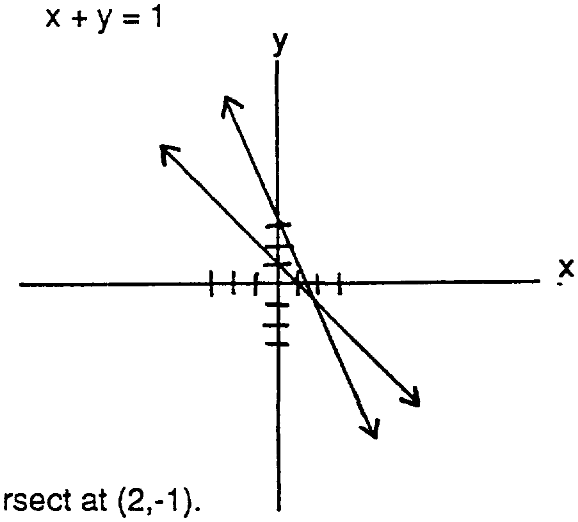


Green Globs
Equation Plotter

Exercise 4
Systems of Linear Equations
in Two Variables

Using *Equation Plotter,* graph each pair of equations below. Locate the point where the graphs intersect. Record the coordinates of the point. What does this point signify? Then show by substitution that this point satisfies both equations.

Example: $2x + y = 3 \rightarrow y = 3 - 2x$
$x + y = 1$

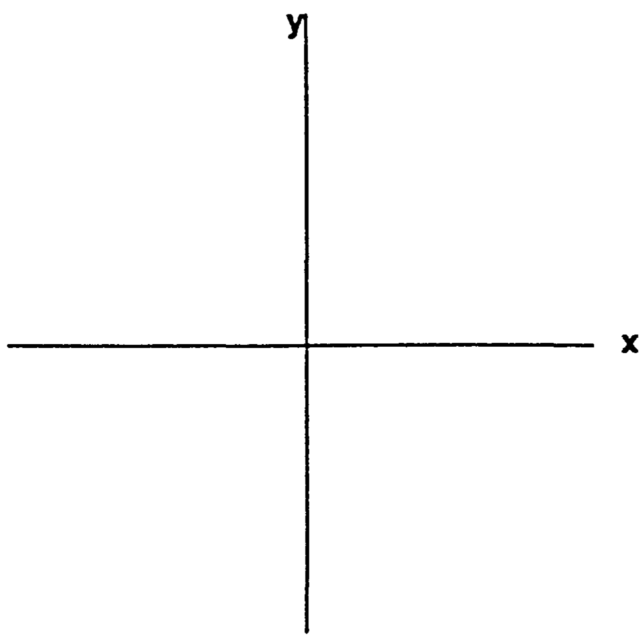


$x + (3 - 2x) = 1$
$3 - x = 1$
$x = 2$
$2 + y = 1$
$y = -1$

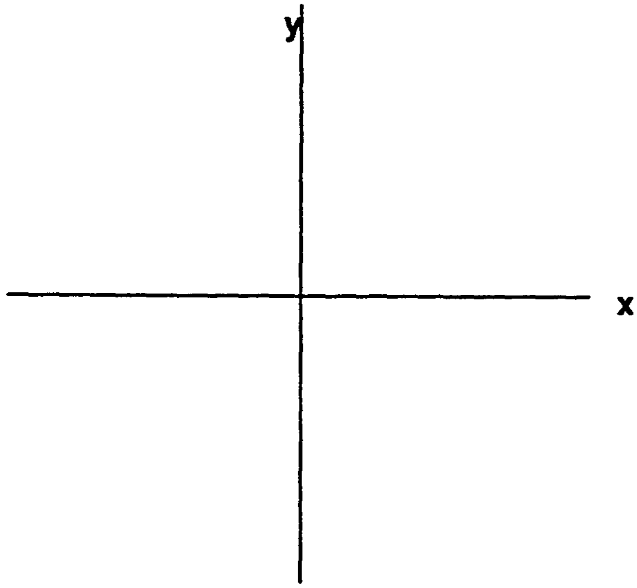
Intersect at (2,-1).

Thus (2,-1)

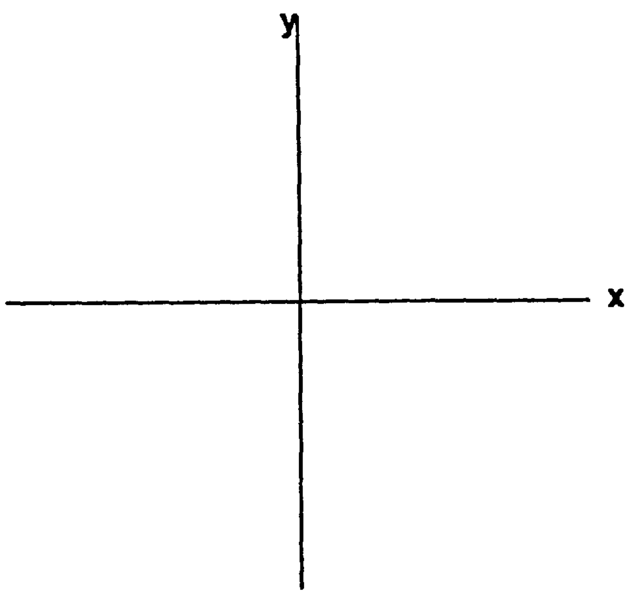
1. $2x+5y=0$
   $2x+y=8$



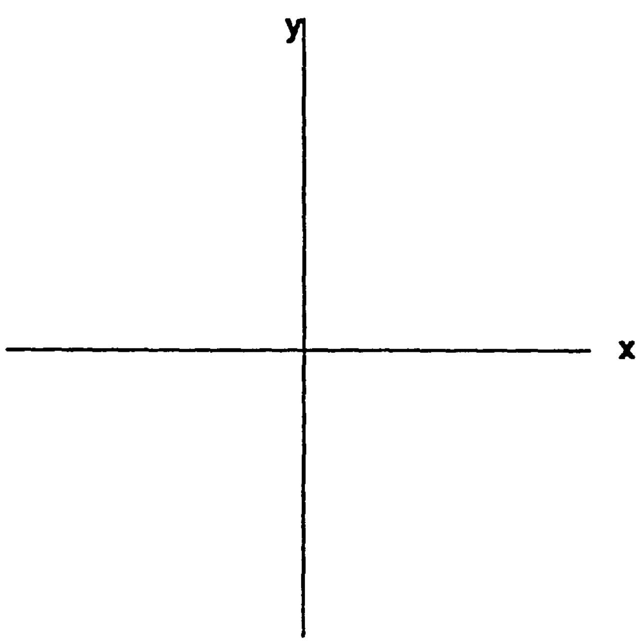
2. $x-2y=-4$
$3x+2y=12$



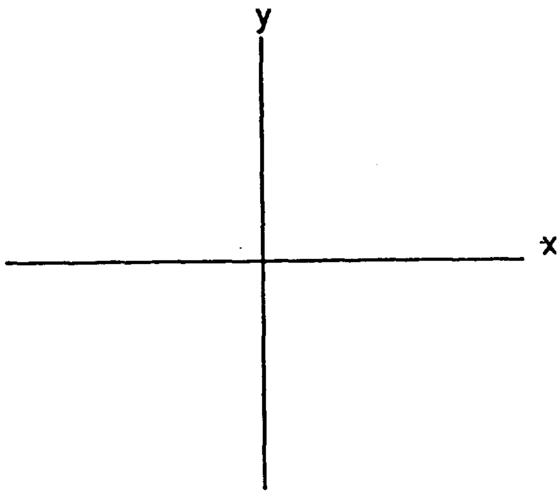
3. $3x+2y-1=0$
$x-2y+13=0$



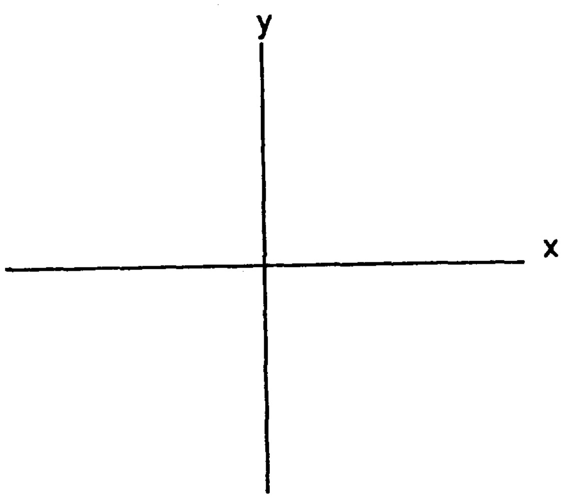
4. $3x+y=-6$
$3x-5y=12$



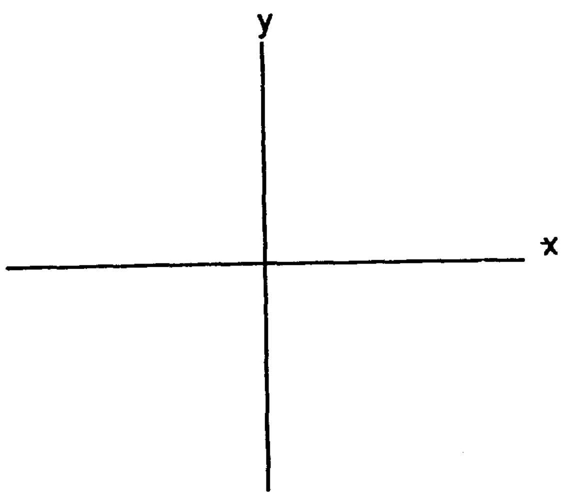
5. $x-2y=5$
$4x+3y=9$



6. $x+2y=1$
$y= (-1/2)x + 4$



7. $-3x+5y=-6$
$6x-10y=12$

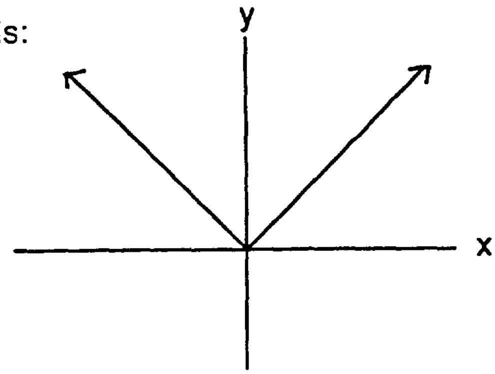


What do you notice is particularly different about numbers 6 and 7? ______________

Green Globs
Equation Plotter

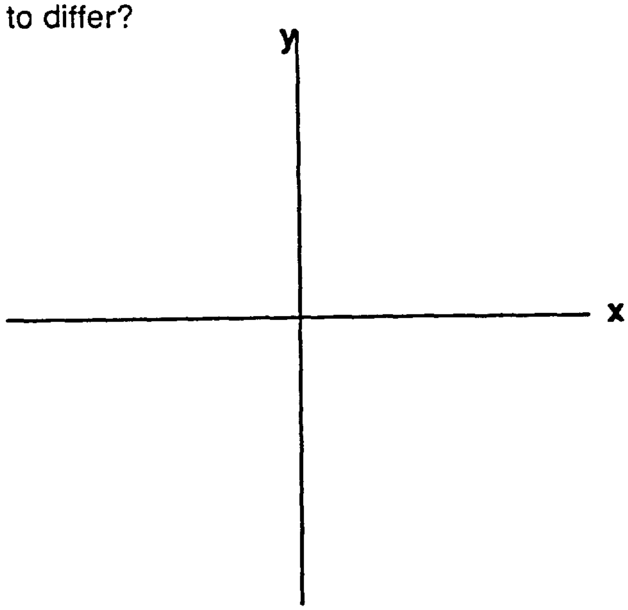
Exercise 5
Absolute Value

The graph of $y = |x|$ is:

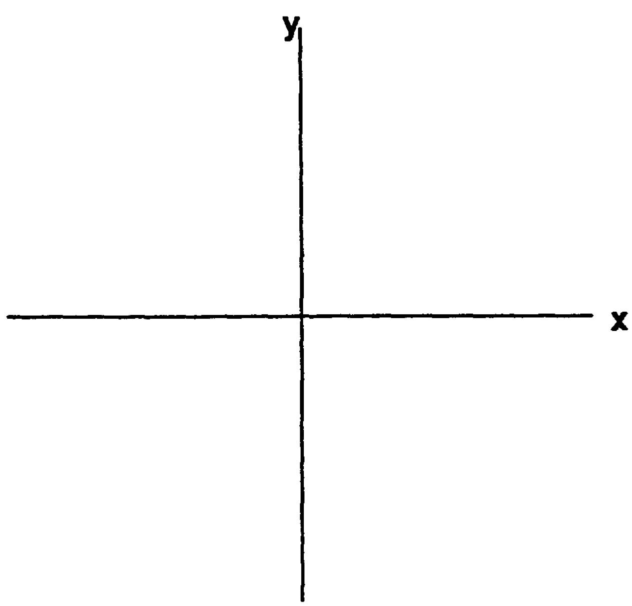


Using *Equation Plotter,* graph each of the equations below. Record the graph that you see on the screen. How does it differ from the graph of $y=|x|$? What part of the equation causes it to differ?

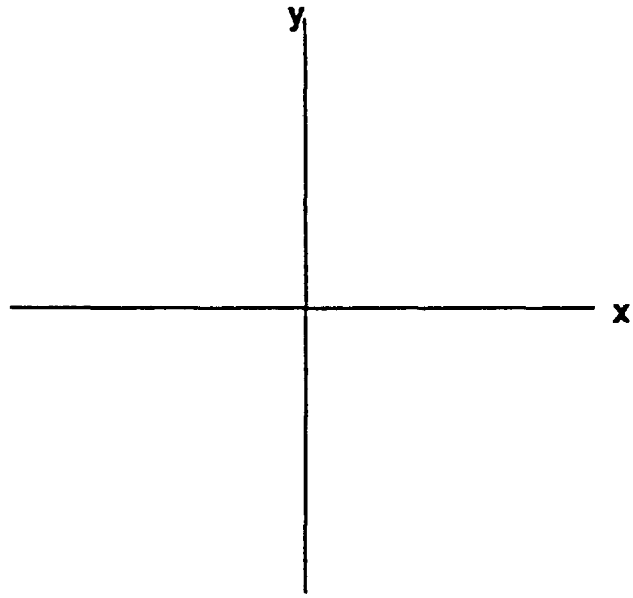
1. $x = |y|$



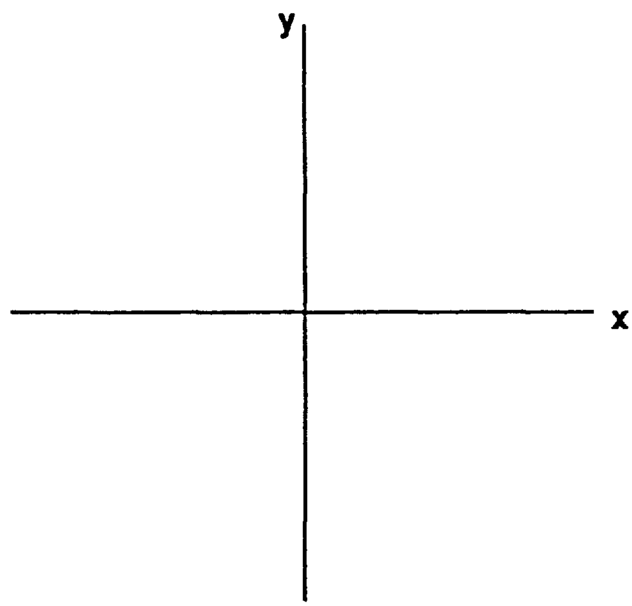
2. $y = |x-1|$



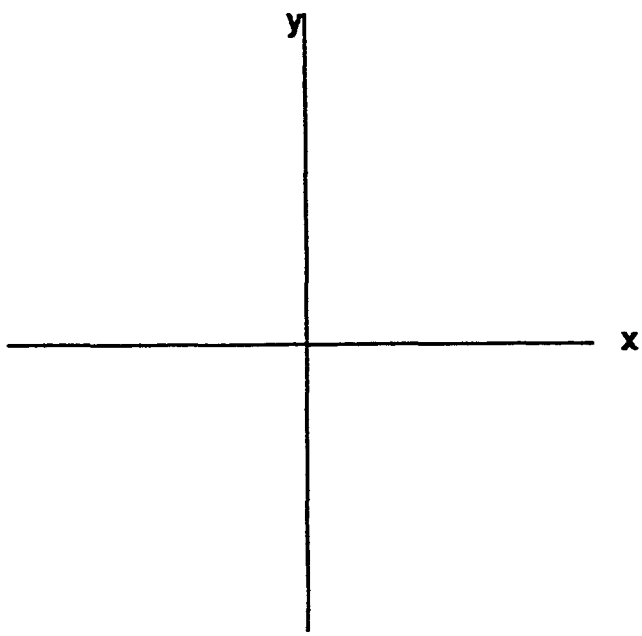
3. $y = |x| - 1$



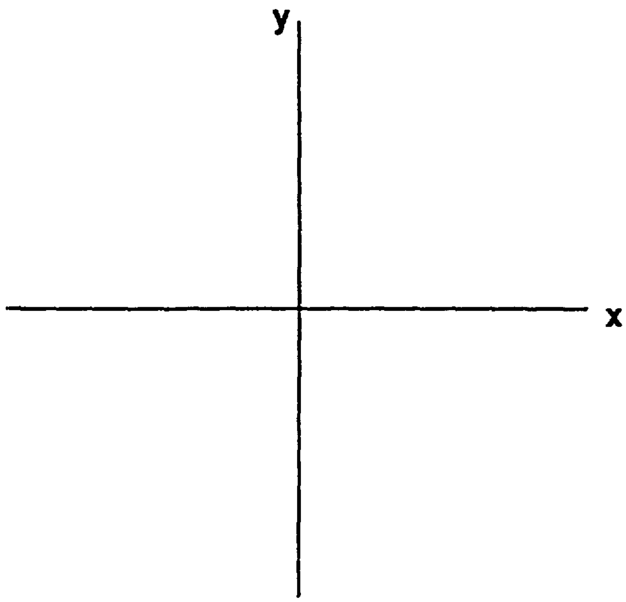
4. $y = |x| - x$



5. $y = x - |x|$



6. $y = |x| + x$



Green Globs
Equation Plotter

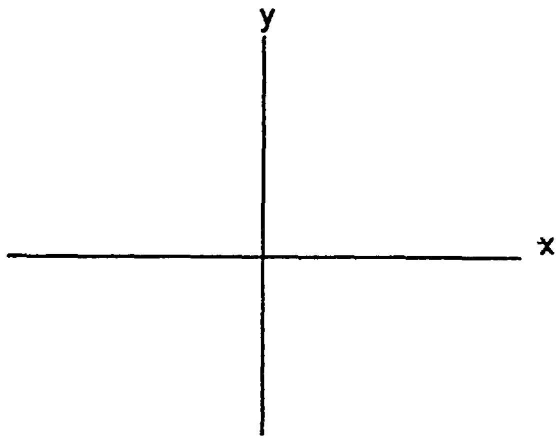
Exercise 6
Quadratic Equations

Using *Equation Plotter*, graph each of the following quadratic equations. Record the graphs that you see on the axes provided.

1. $y = x^2$

   $y = x^2 + 2$

   $y = x^2 - 2$

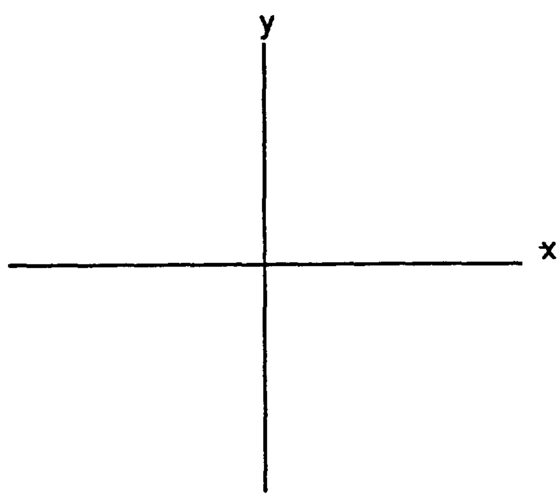


How do the graphs differ? What part of each equation causes them to differ?

2. $x = y^2$

   $x = y^2 + 2$

   $x = y^2 - 2$

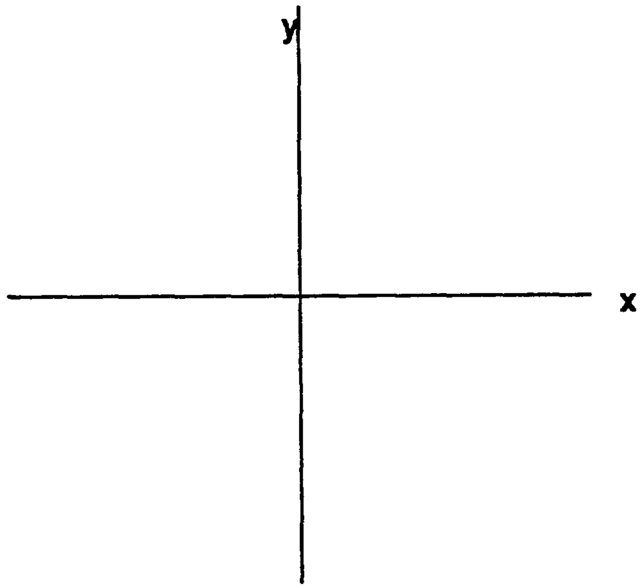


How are these graphs different from the graphs in number 1? What part of each equation causes them to be different?

3. $y = (1/2)x^2$

$y = x^2$

$y = 2x^2$



How do the above graphs differ? What parts of these equations cause the graphs to differ? ______________________________

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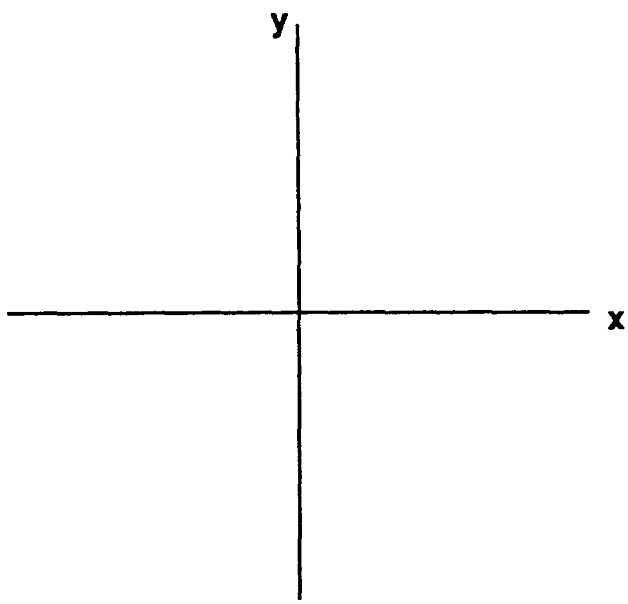
4. $y = -(1/2)x^2$

$y = -x^2$

$y = -2x^2$



How do the above graphs differ? What parts of these equations cause the graphs to differ? ______________________________

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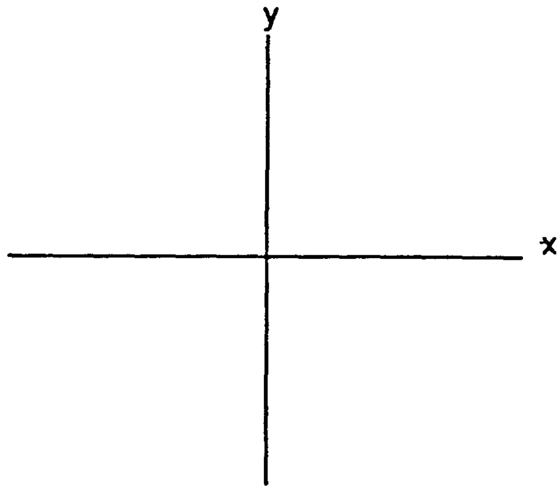
Green Globs
Equation Plotter

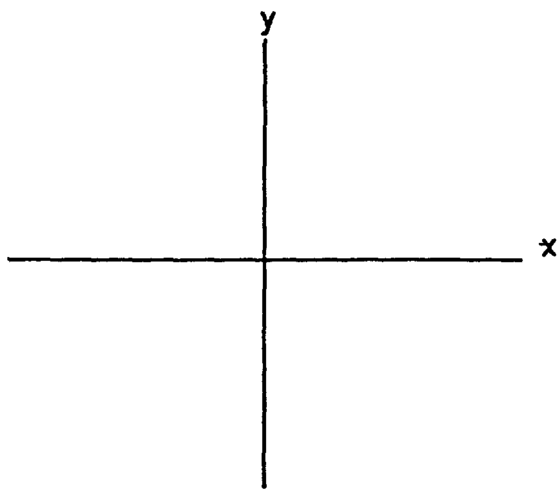
Exercise 7
More Quadratic Equations

Sketch the graph of each of the following and then check yourself using *Equation Plotter.* Do not worry if your sketch is not exactly right. If your sketch has the same shape and falls in the same quadrants, you understand the significant parts of the equation.

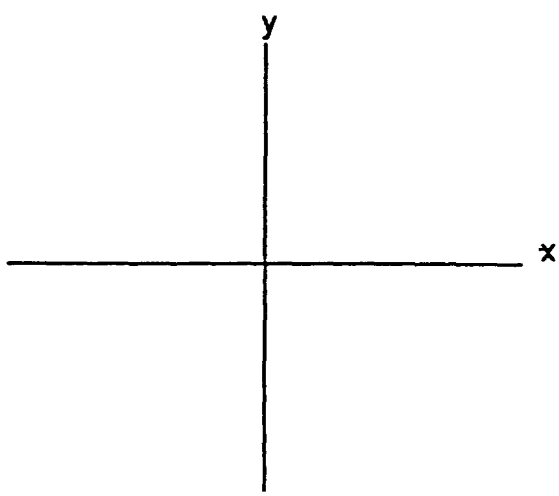
1. $y = -x^2 - 3x$



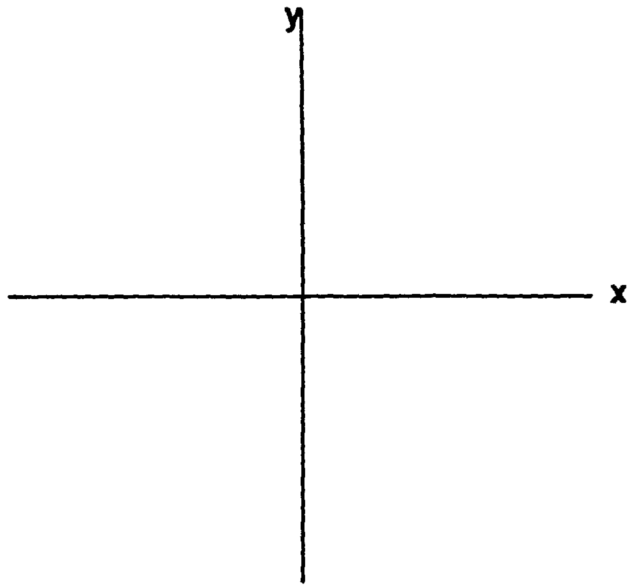
2. $y = 4x - x^2$



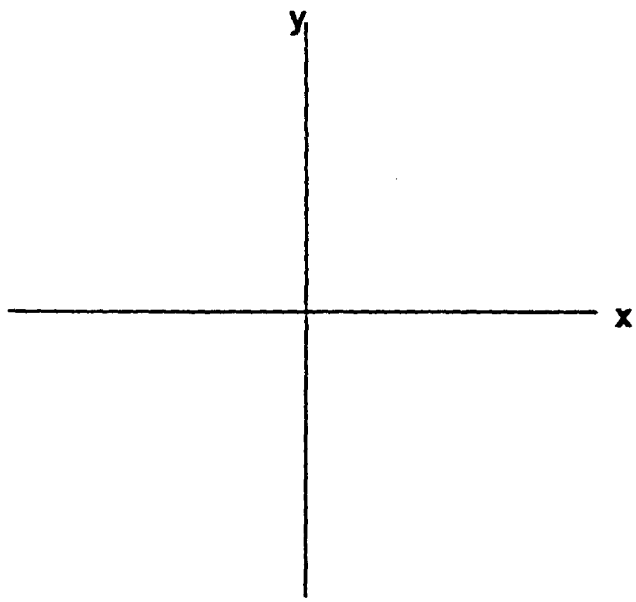
3. $y = -x^2 - 8x - 15$



4. $y = x^2 - 3x - 10$



5. $y = x^2 + 9x + 20$



Green Globs
Equation Plotter

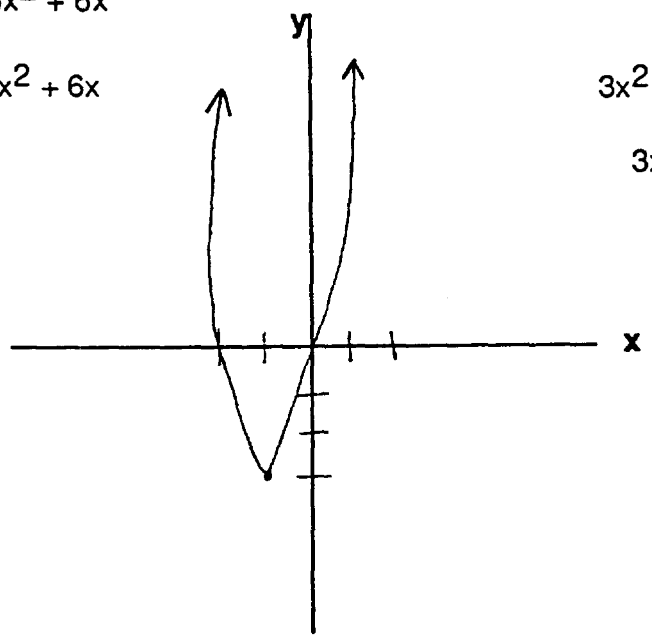
Exercise 8
Factoring Second Degree Polynomials

[Note to teacher: Students will need to be able to apply the definition of factor and be able to factor binomials and trinomials.]

Using *Equation Plotter*, factor each of the following polynomials by graphing. Then set each polynomial equal to zero, factor the polynomial, solve for x, and check the solutions.

Example: $3x^2 + 6x$

$y = 3x^2 + 6x$

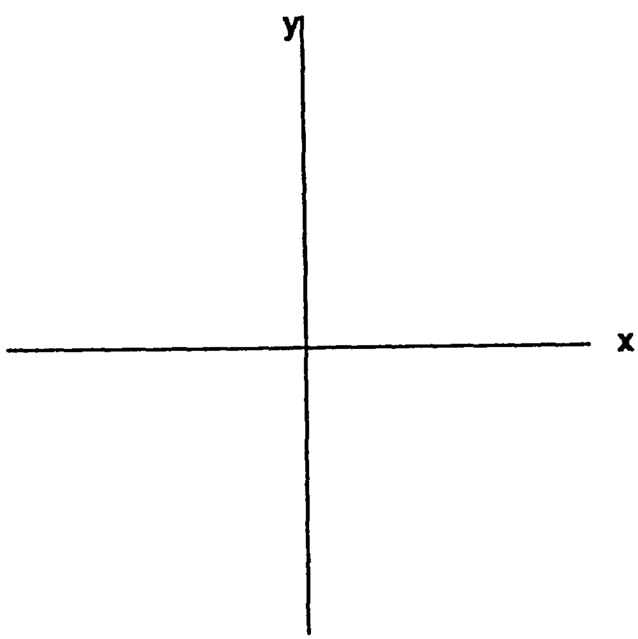


$3x^2 + 6x = 0$

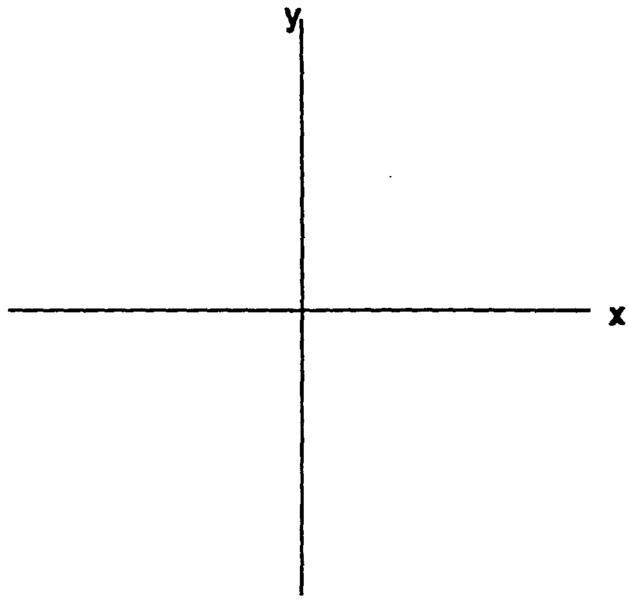
$3x(x + 2) = 0$

$x = 0, -2$

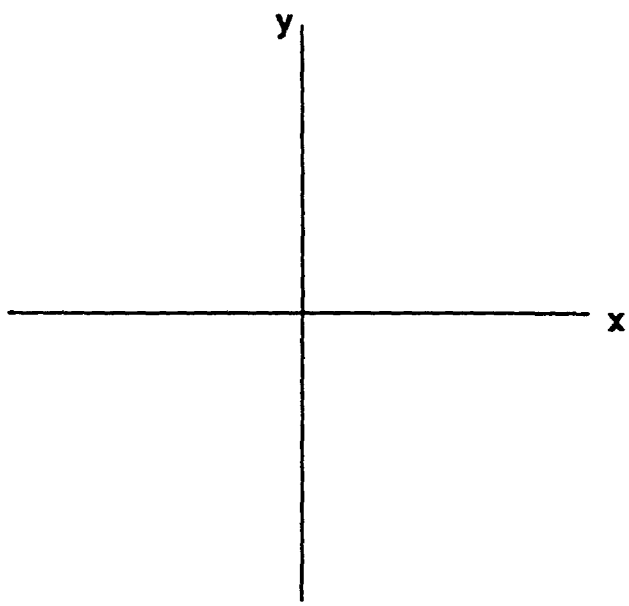
1. x^2-16



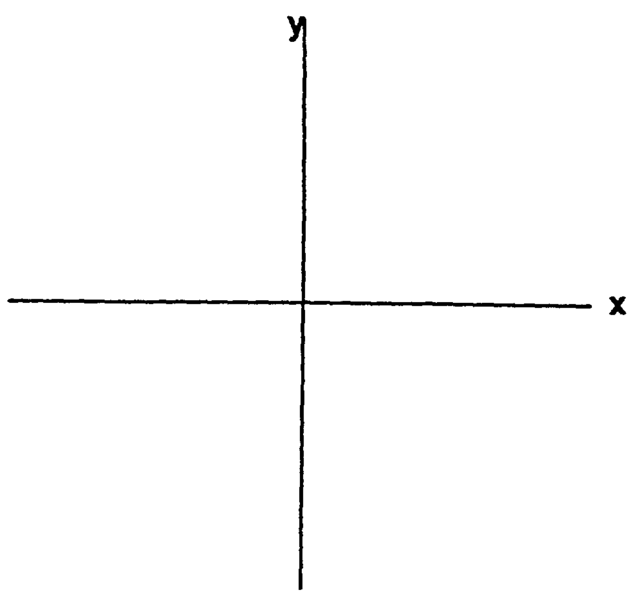
2. $9x^2 - 1$



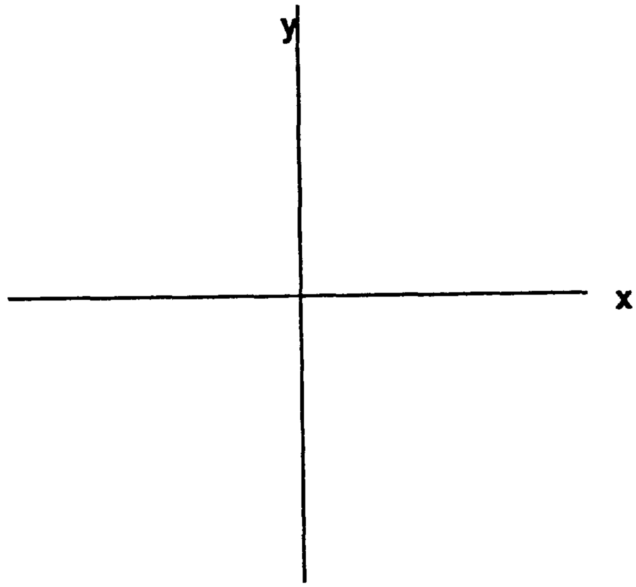
3. $x^2 - 8x + 16$



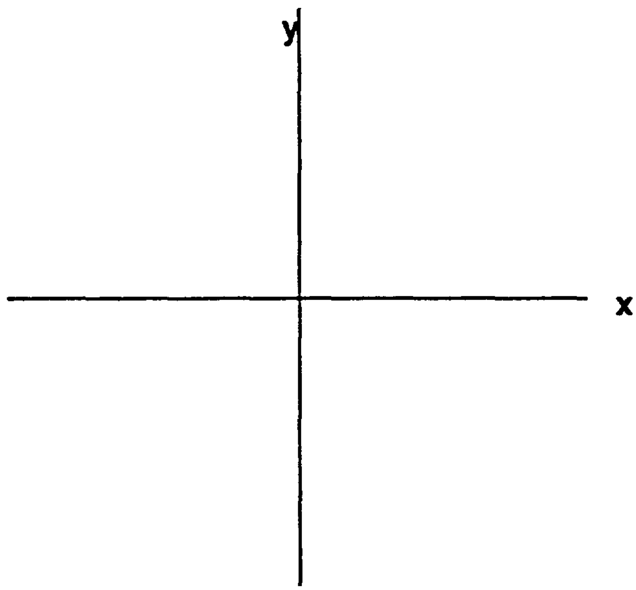
4. $x^2 + 6x + 9$



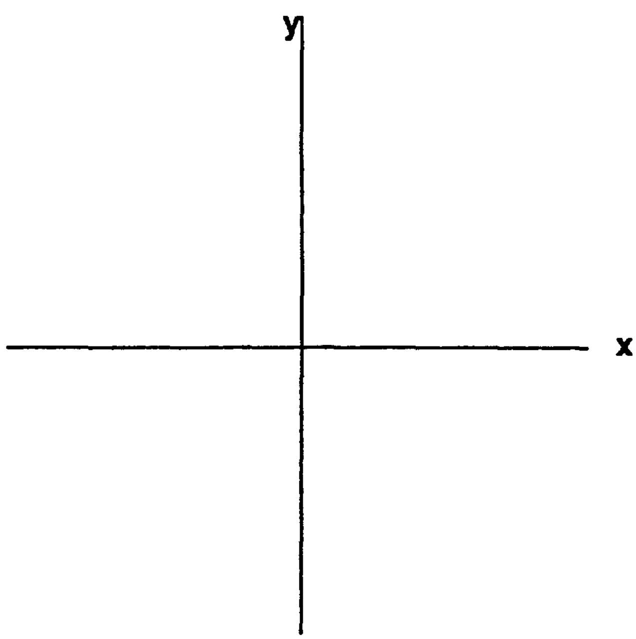
5. $4x^2 + 4x + 1$



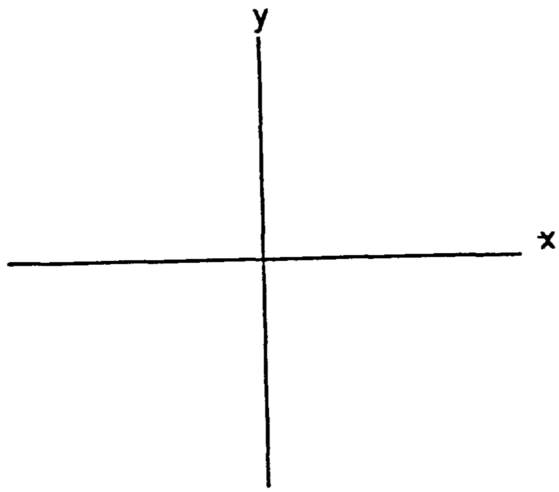
6. $x^2 - 12x + 36$



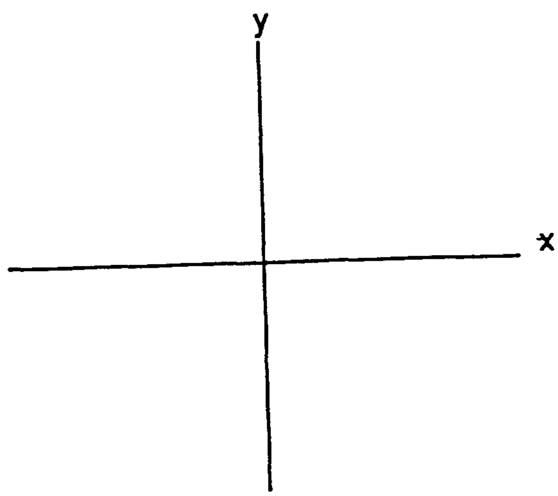
7. $4x^2 + 8x + 3$



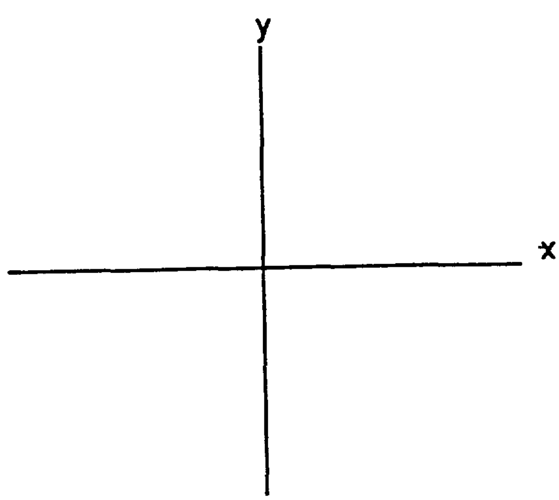
8. $x^2 + 9x + 14$



9. $x^2 - 9x + 12$



10. $x^2 - 8x + 9$



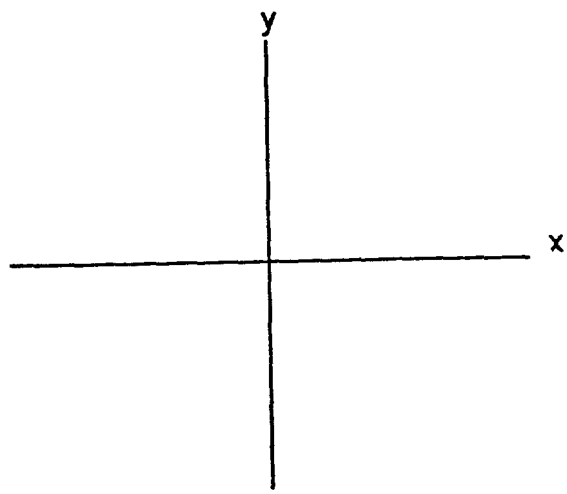
Did you notice anything different about numbers 9 and 10? If so, explain?

Green Globs
Equation Plotter

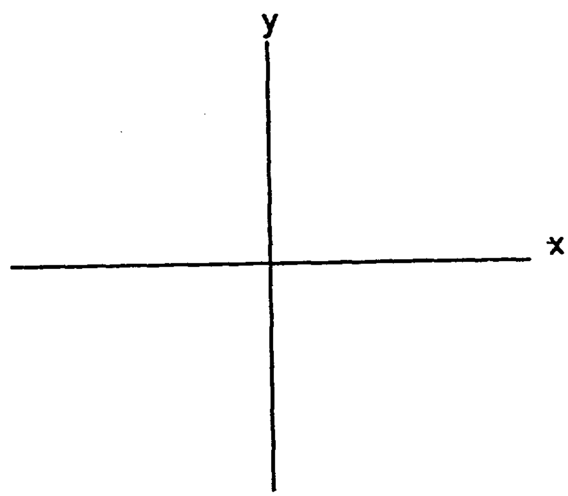
Exercise 9
Factoring Polynomials of Second Degree or Higher

Using *Equation Plotter,* factor each of the following polynomials by graphing. Watch for a pattern in the graphs and in the solutions of their related equations.

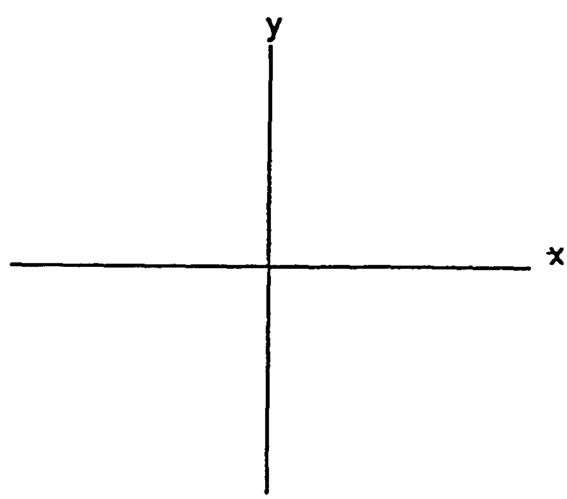
1. $x^3 - 1$



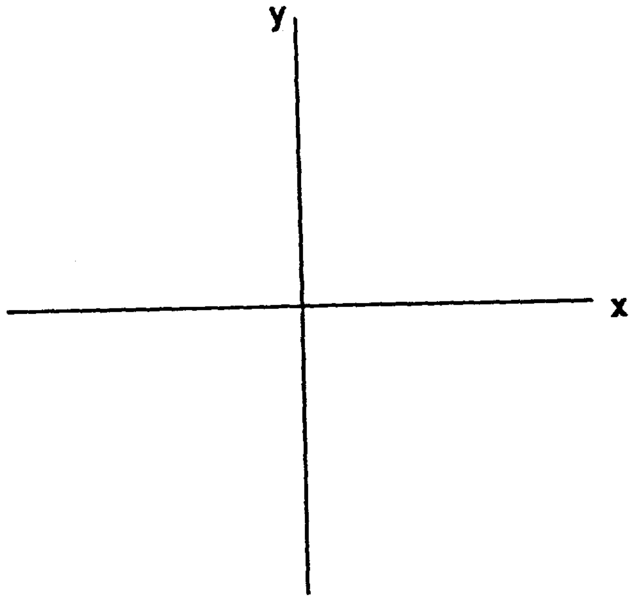
2. $3x^2 + 6x$



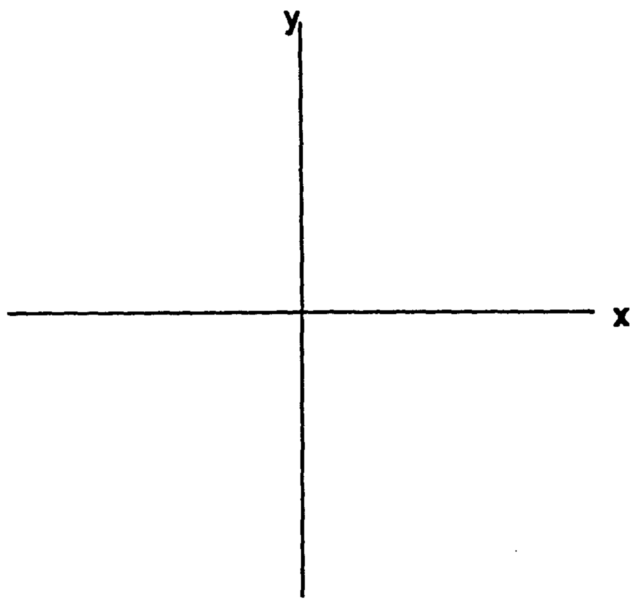
3. $x^2 - 16$



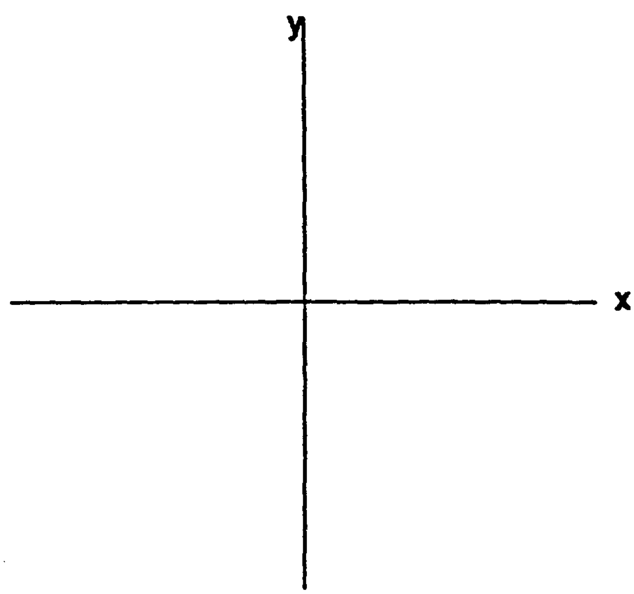
4. $x^4 - 4x^2$



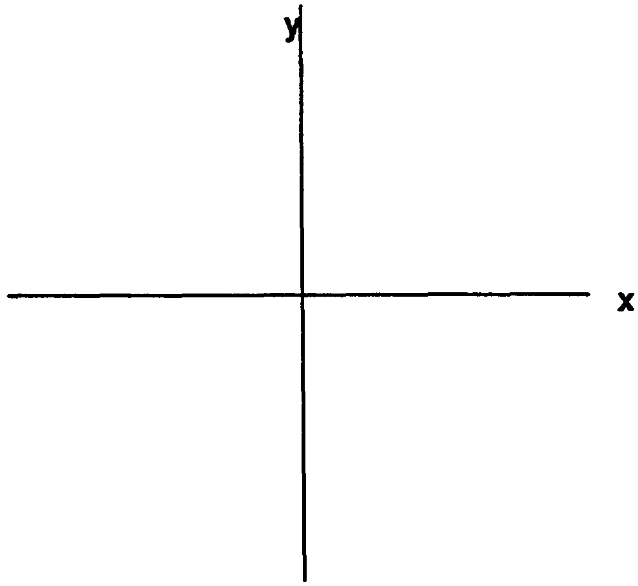
5. $x^3 - x$



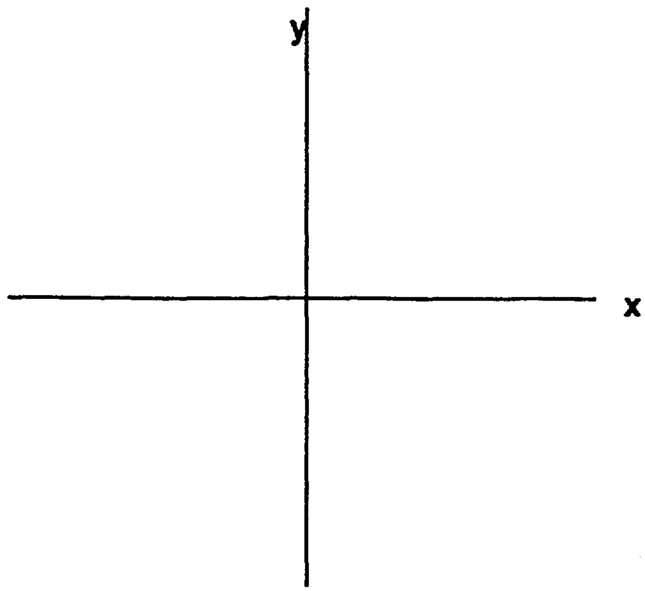
6. $x^3 - 12x^2 + 36x$



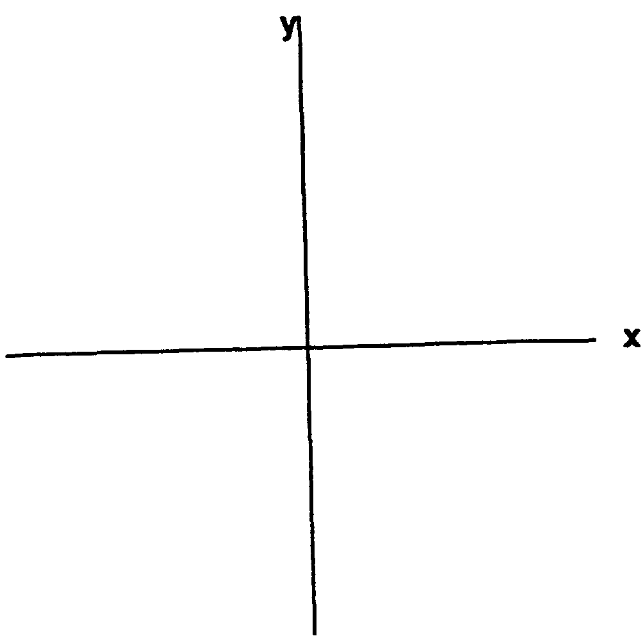
7. $x^2 - 12x + 36$



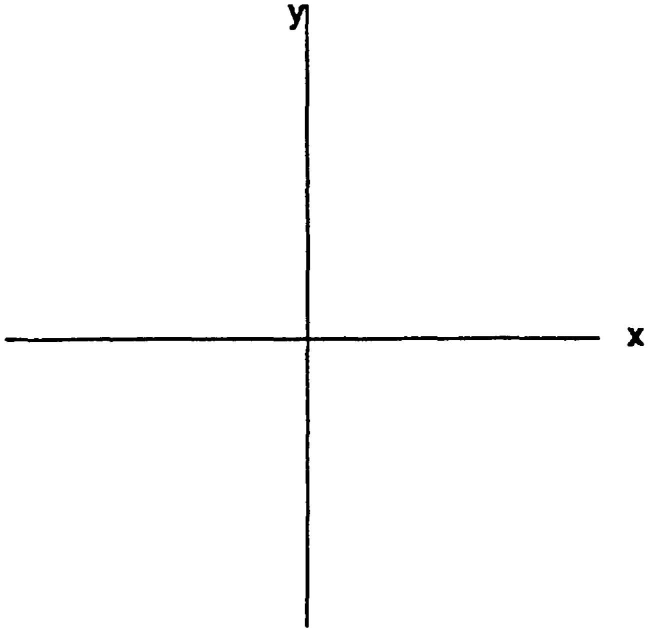
8. $x^3 - 27$



9. $x^6 + x^3 + 1$



10. $64 - x^6$



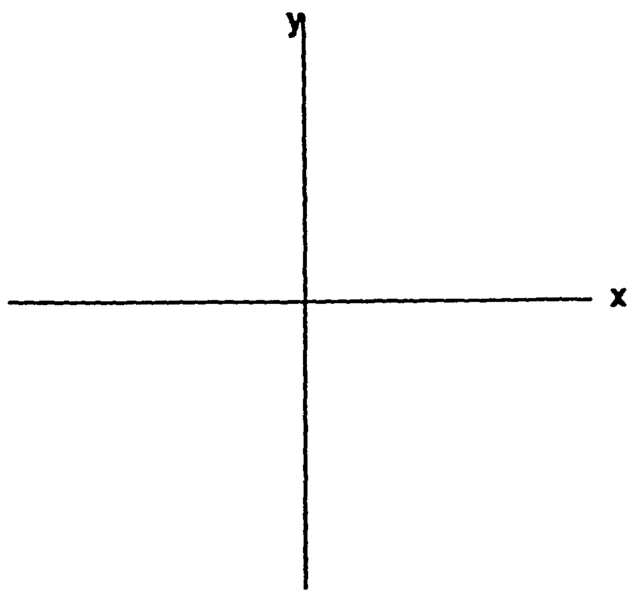
What can you deduce from this exercise about the degree of an equation and its number of solutions?

Green Globs
Equation Plotter

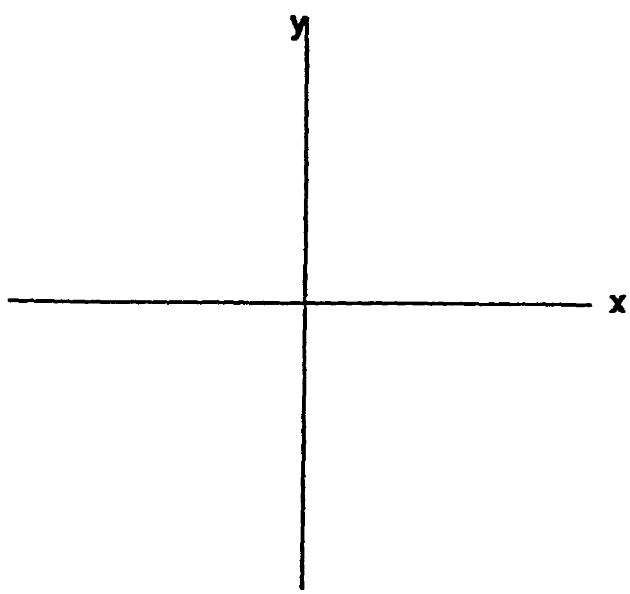
Exercise 10
Parabolas

Using *Equation Plotter*, graph each set of equations. Record the graphs that you see. Then, explain what part of the equations cause them to differ..

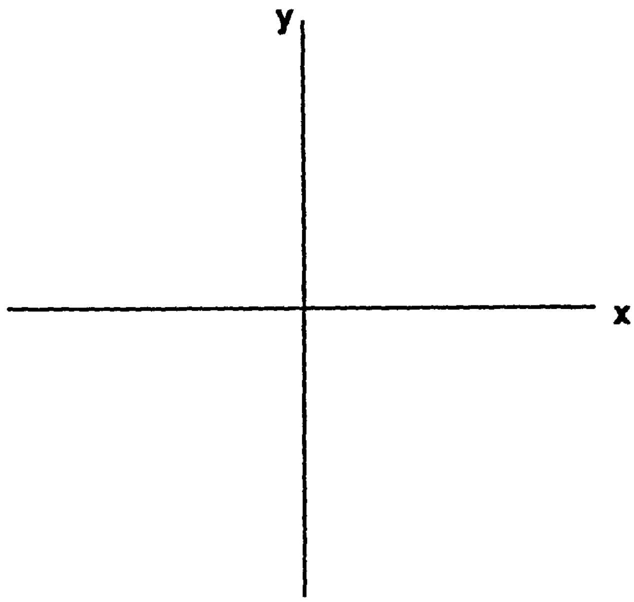
1. $y = x^2$
   $y = -x^2$



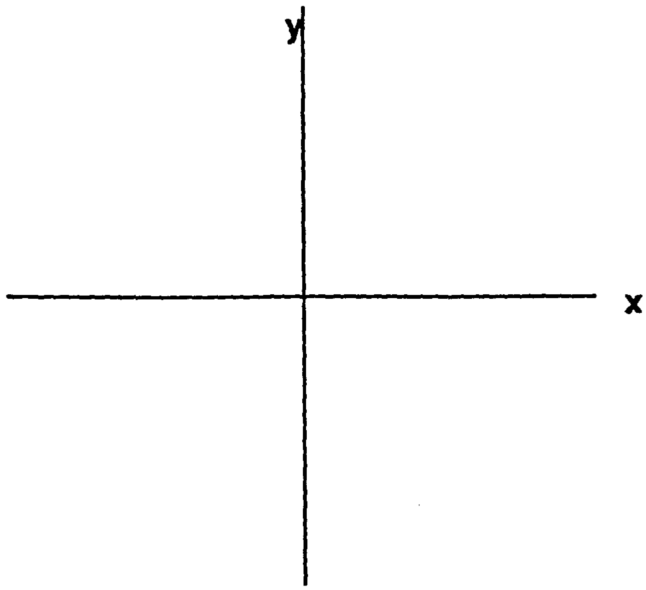
2. $y = x^2$
   $y = 5x^2$
   $y = 10x^2$



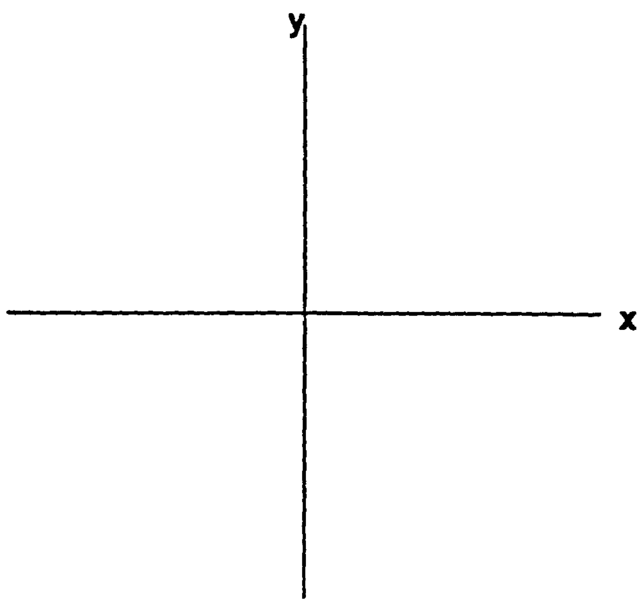
3. $y = -x^2$
   $y = -(1/2)x^2$
   $y = -(1/16)x^2$



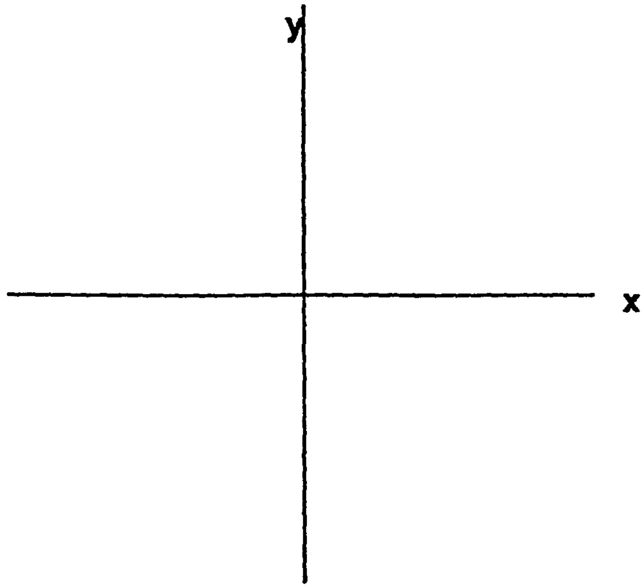
4. $y = x^2$
   $y = (x-2)^2$
   $y = (x+2)^2$



5. $y = x^2$
   $y = x^2 + 2$
   $y = x^2 - 6$



6. $y = (x-4)^2 + 4$
$y = (x+2)^2 - 3$
$y = -(x-1)^2 + 2$

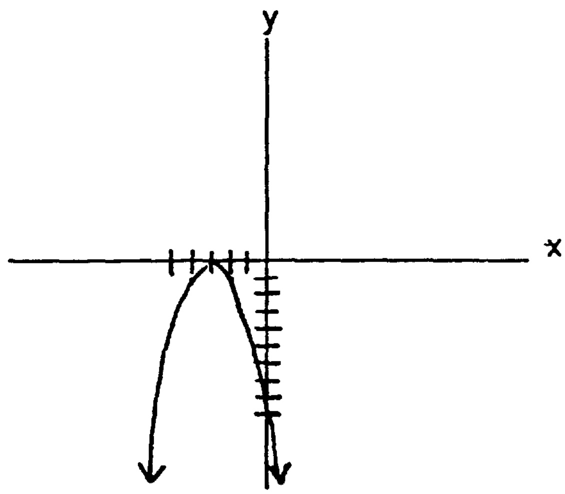


Green Globs
Equation Plotter

Exercise 11
More Parabolas

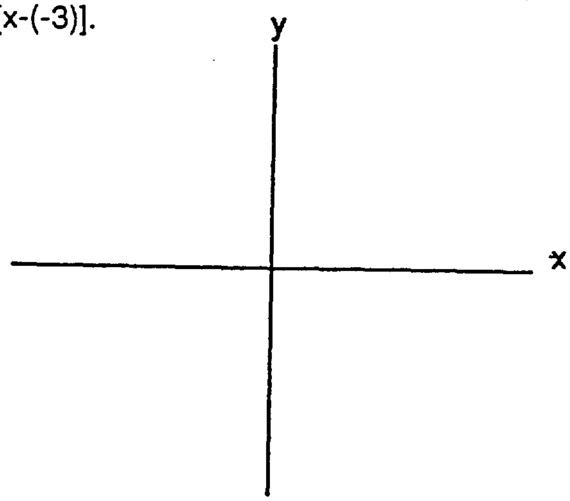
Using *Equation Plotter*, graph each of the following. Sketch the graph that you see and explain why it looks as it does.

Example: $y = -(x + 3)^2$

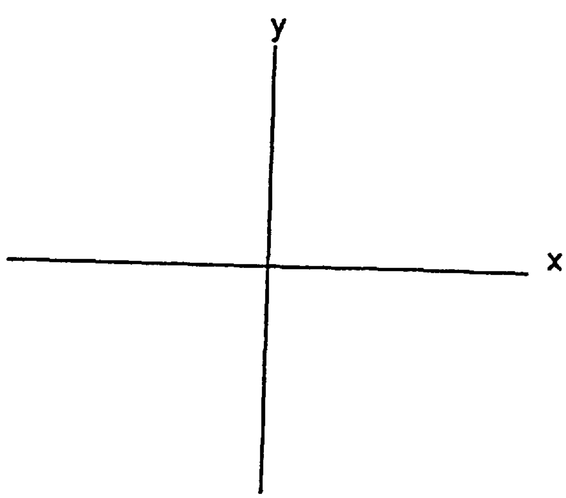


It opens downward because of the negative sign. The vertex is at (-3,0) because (x+3) = [x-(-3)].

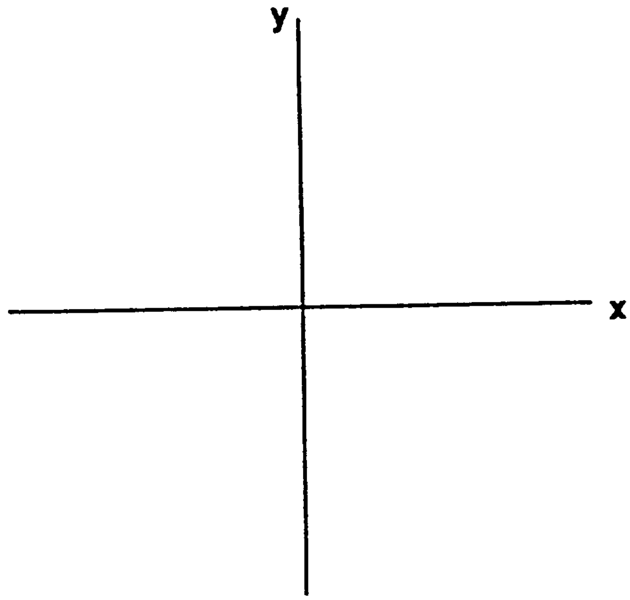
1. $y = (1/3)x^2$



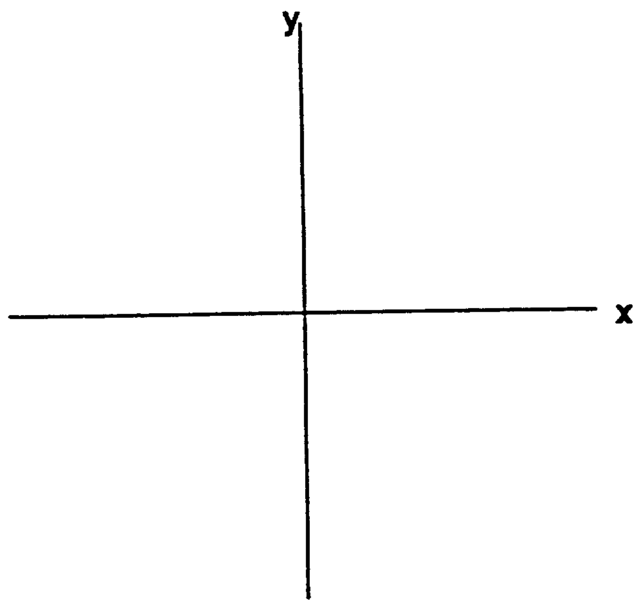
2. $y - 5 = -(x+2)^2$



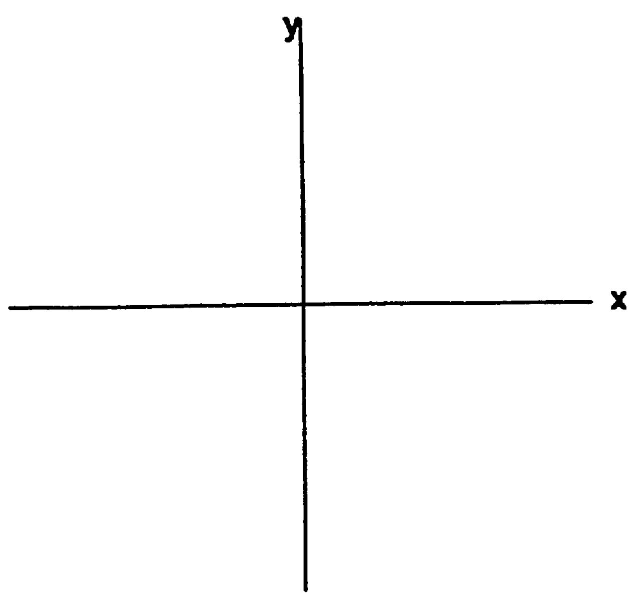
3. $y = -3x^2$



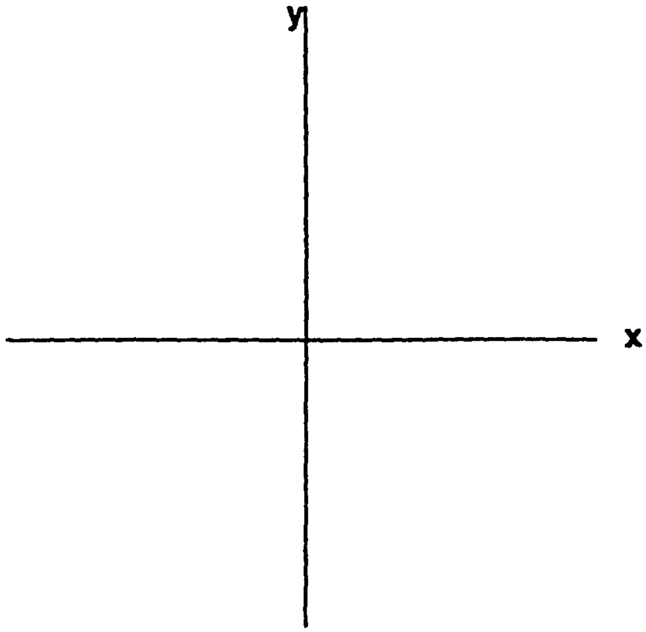
4. $y + 2 = (x-1)^2$



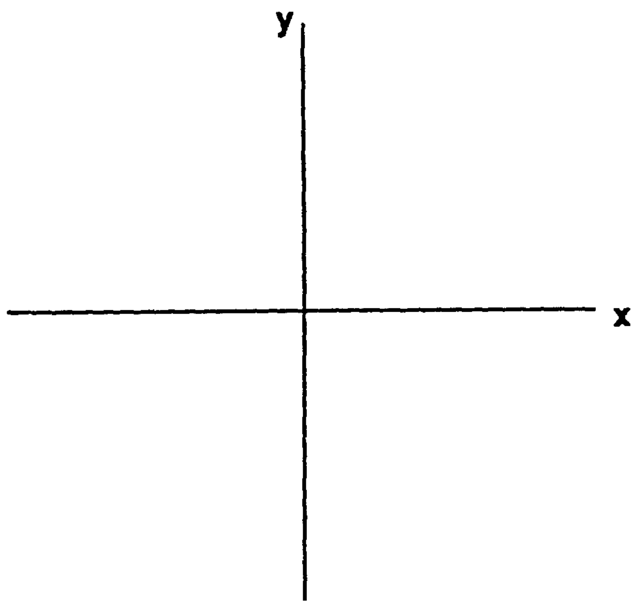
5. $y - 8 + -2(x-3)^2$



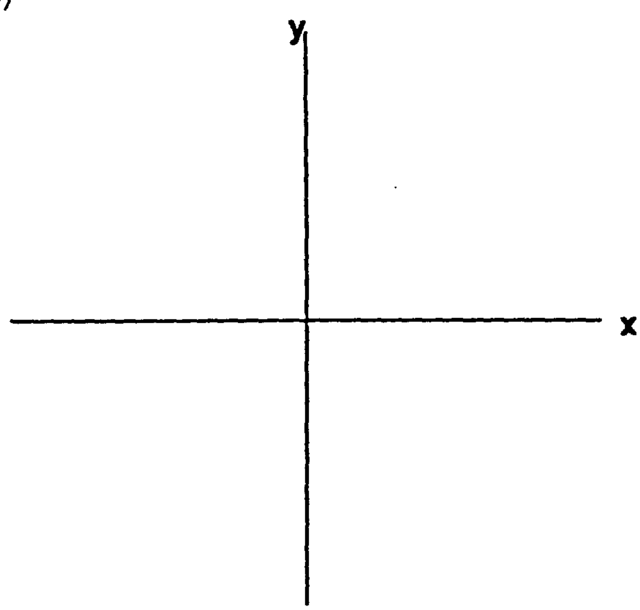
6. $y - 4 = -x^2$



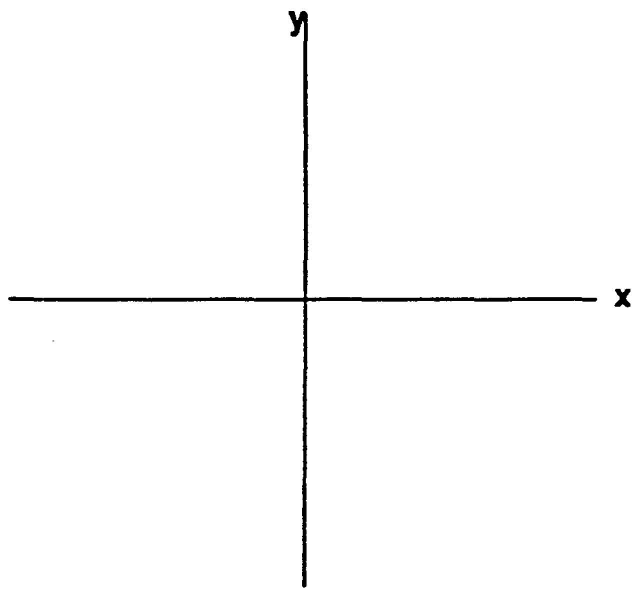
7. $y + 1 = -2(x-2)^2$



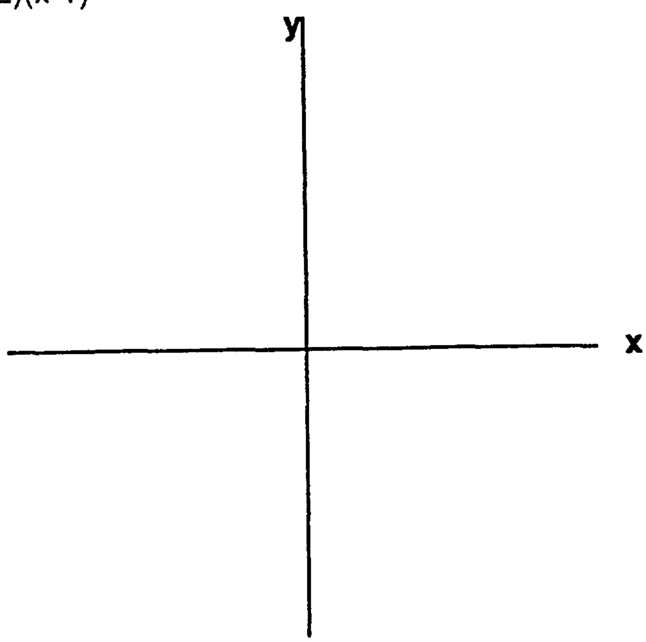
8. $y - 3 = -(1/3)(x+6)^2$



9. $y = (x+3)^2$



10. $y - 2 = (1/2)(x-1)^2$

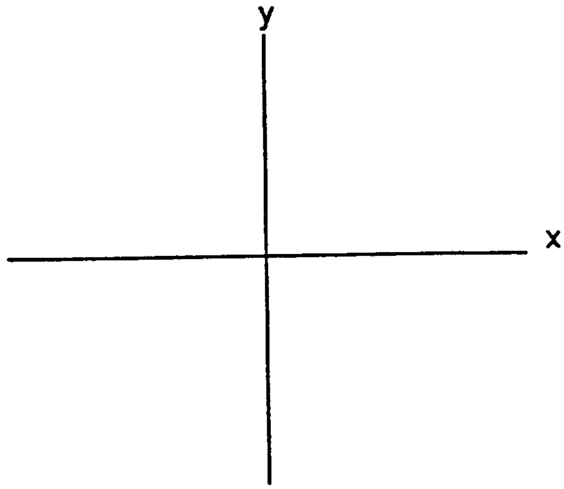


Green Globs
Equation Plotter

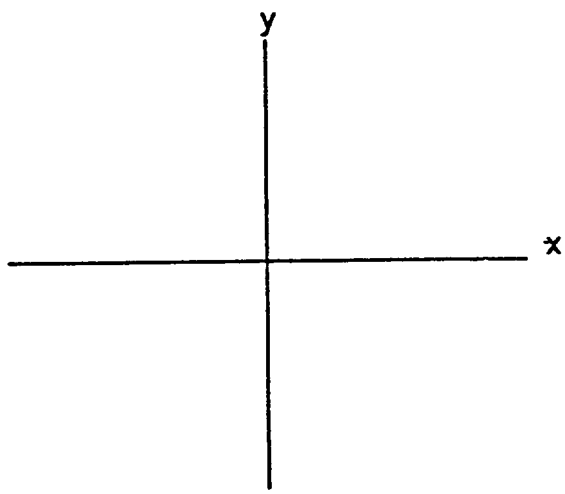
Exercise 12
Hyperbolas

Using *Equation Plotter*, graph each of the following. Record the graph that you see. Draw in the asymptotes as dotted lines. Give a short explanation of how the parts of the equation affect its graph.

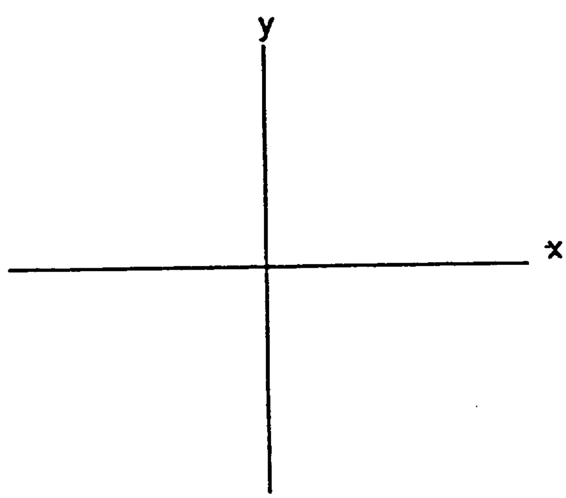
1. $4x^2 - y^2 = 16$



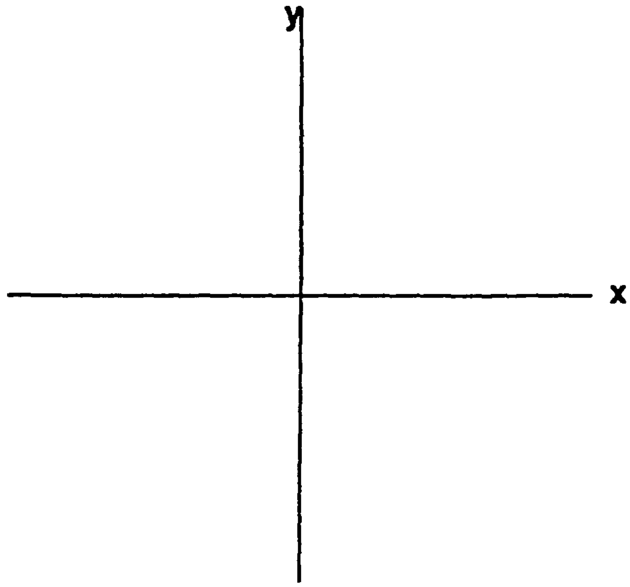
2. $25x^2 - 4y^2 = 100$



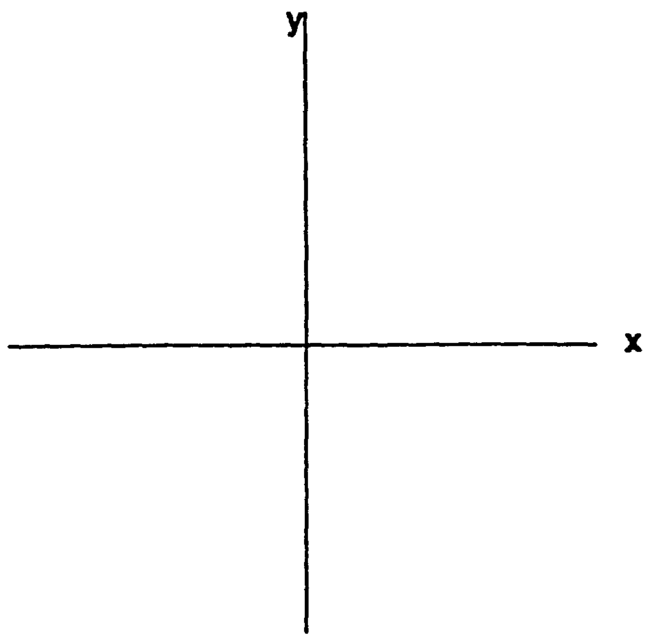
3. $x^2 - 25y^2 + 25 = 0$



4. $25x^2 - 144y^2 = 3600$



5. $4x^2 - y^2 + 1 = 0$

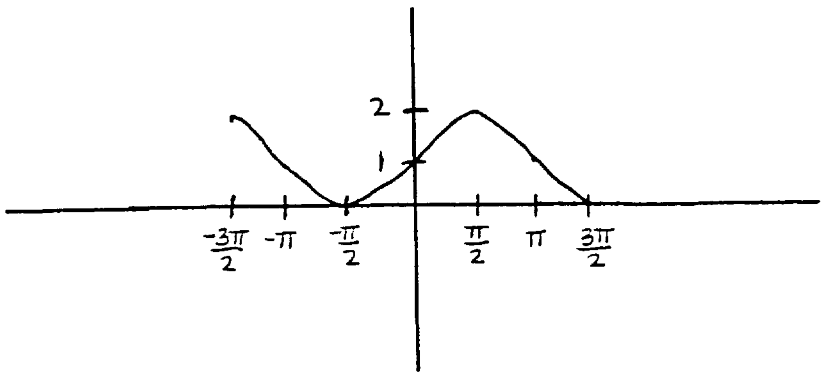


Green Globs
Equation Plotter

Exercise 13
Sine

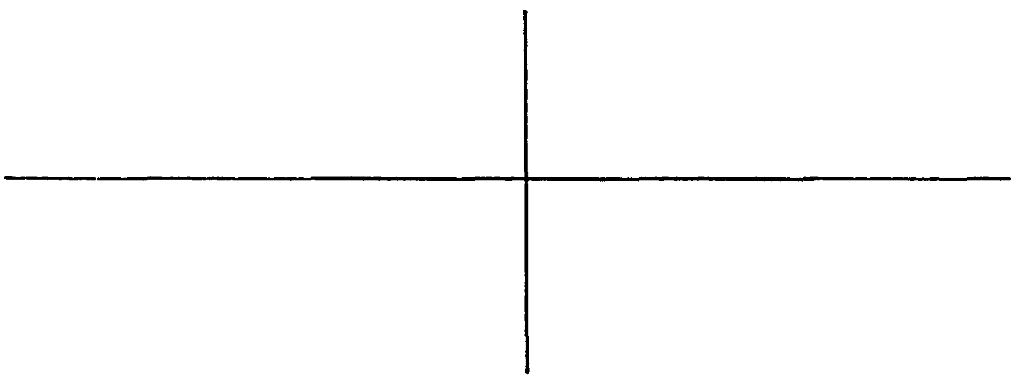
Using *Equation Plotter*, graph each of the following equations. Record the graph that you see. Explain how the parts of the equation make its graph different from y = sin x.

Example: y = sin x + 1

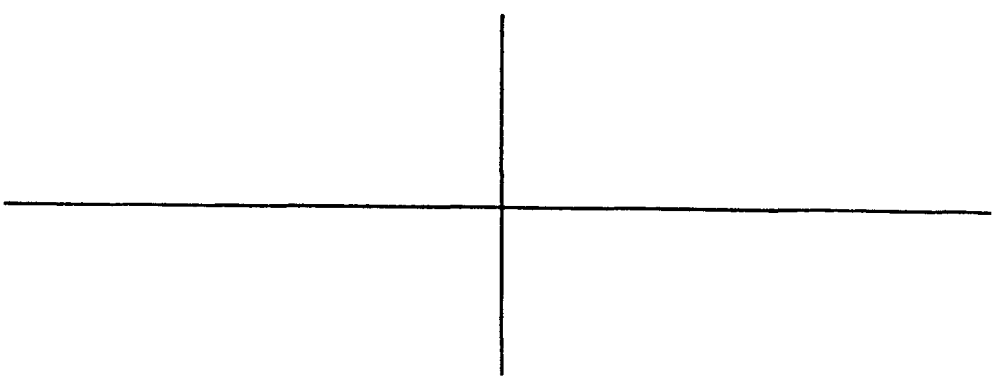


The +1 causes the graph to be elevated by 1 on the y-axis. This is true because (sin 0) + 1 = 1.

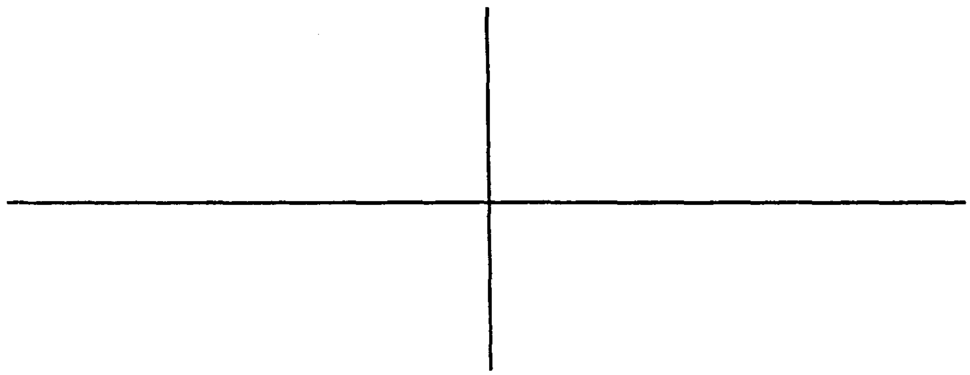
1. y = sin x + 2



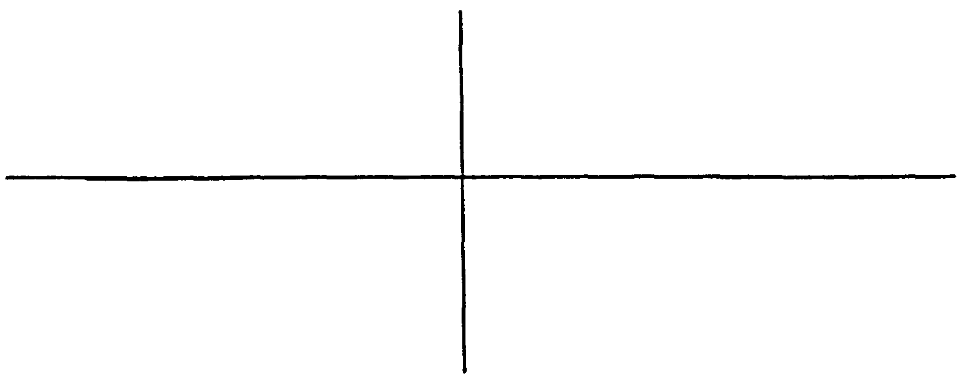
2. y = 2 sin x



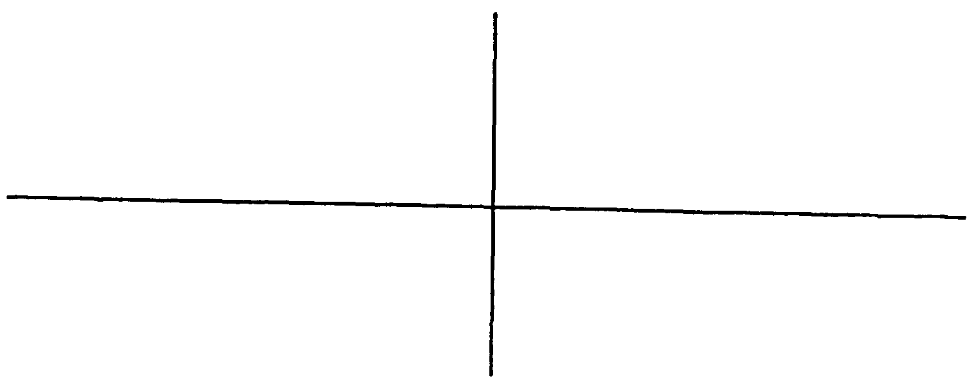
3. $y = \sin 2x$



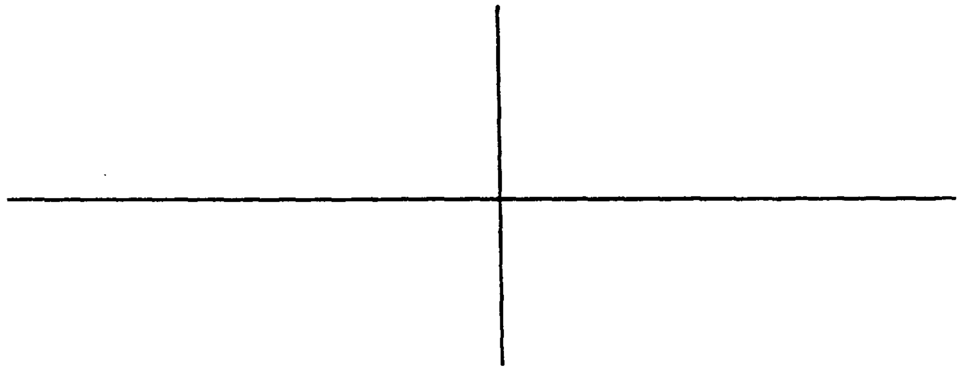
4. $y = 2 + 3 \sin x$



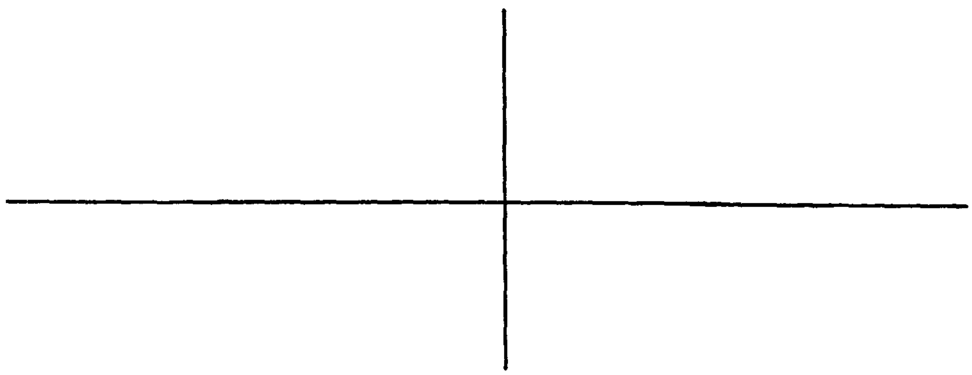
5. $y = (1/2) \sin x$



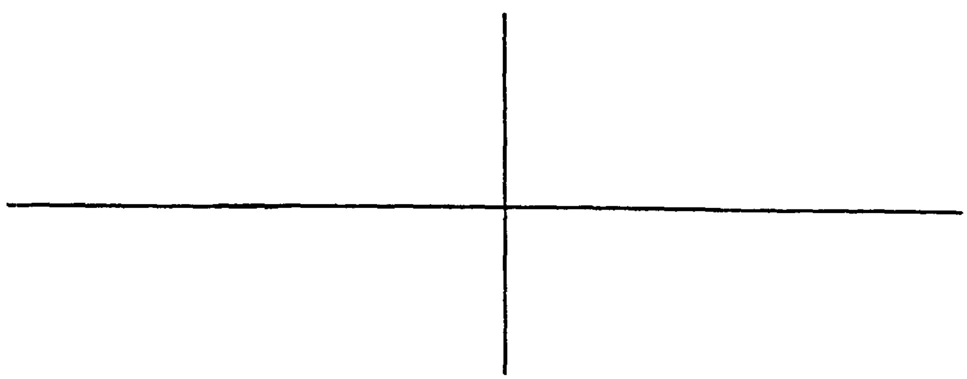
6. $y = 3 \sin 3x$



7. $y = \sin 2\pi x$



8. $y = \sin 4x + 4$

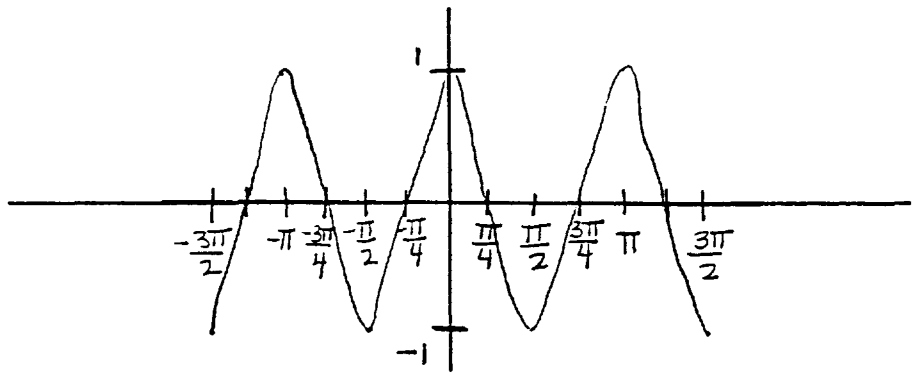


Green Globs
Equation Plotter

Exercise 14
Cosine

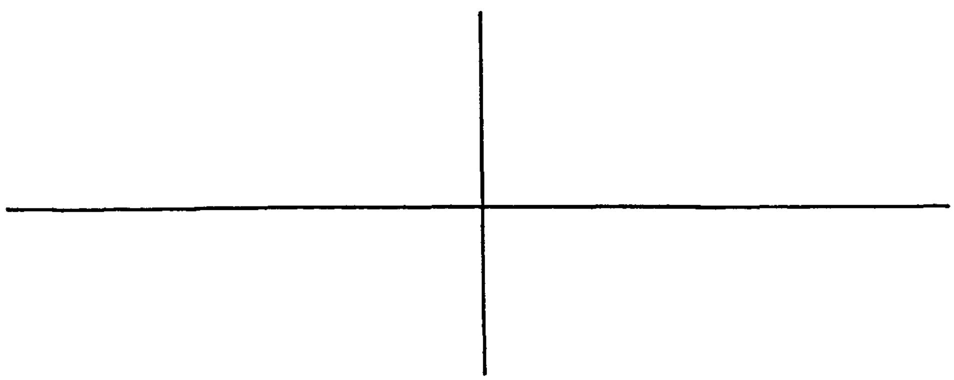
Using *Equation Plotter*, graph each of the following equations. Record the graph that you see. Explain how the parts of the equation make its graph different from y = cos x.

Example: $y = \cos 2x$

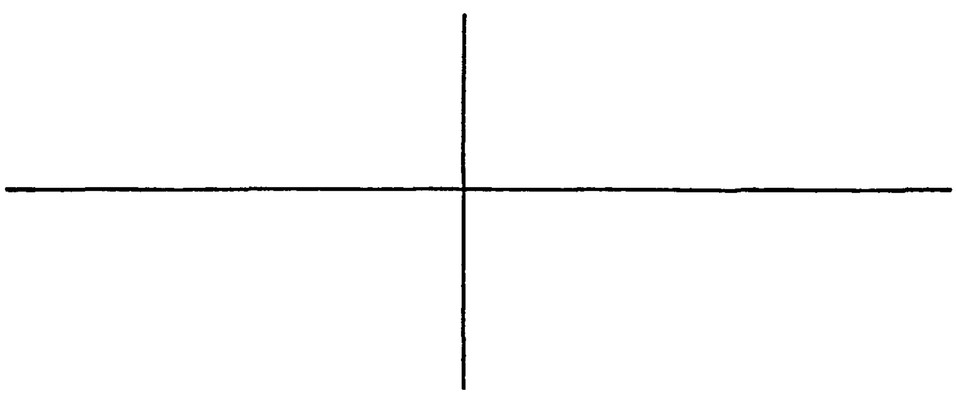


The graph crosses the x-axis sooner (at $\pi/4$) than in $y = \cos x$ (at $\pi/2$). This is true because $y = \cos(\pi/2) = \cos 2(\pi/4)$.

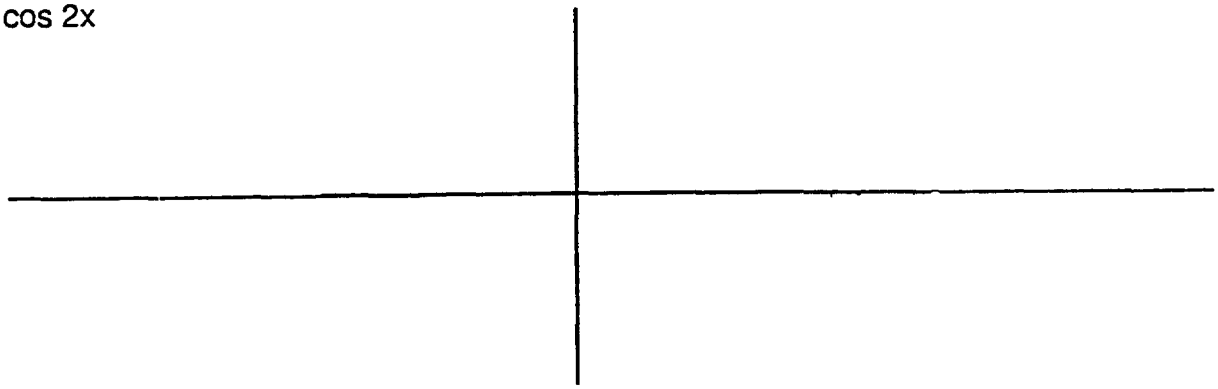
1. $y = \cos x + 2$



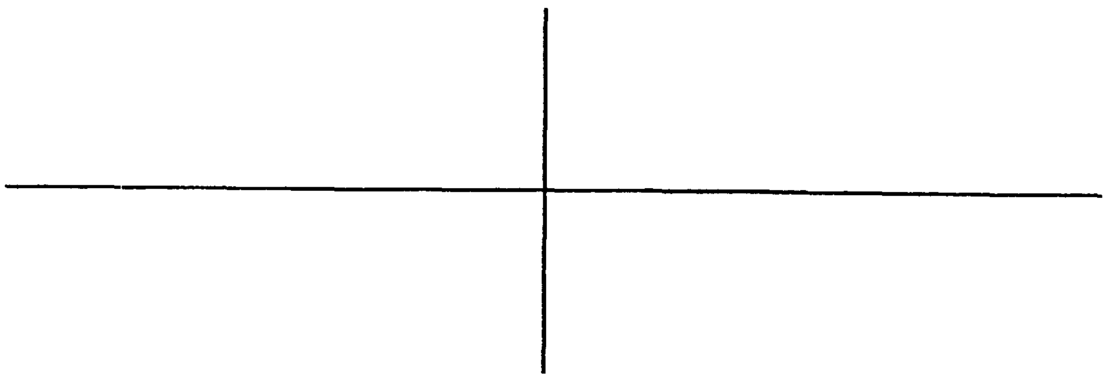
2. $y = 2 \cos x$



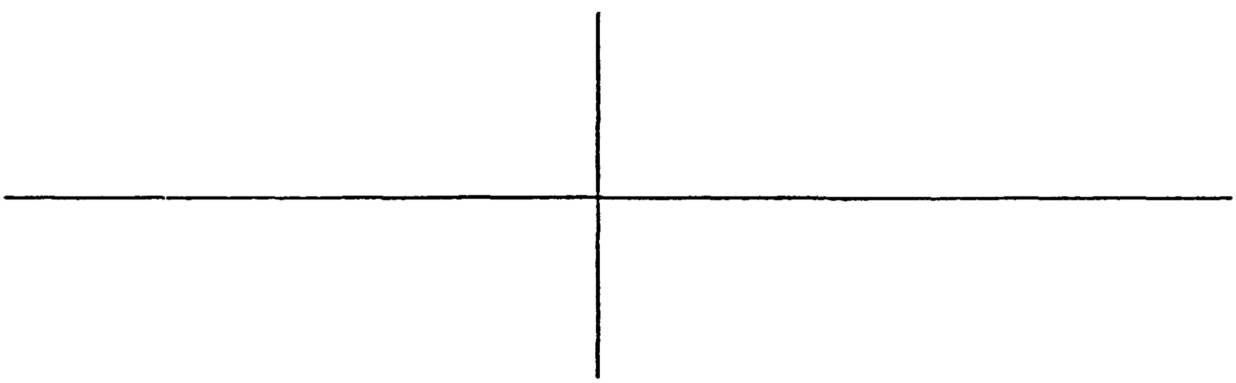
3. $y = \cos 2x$



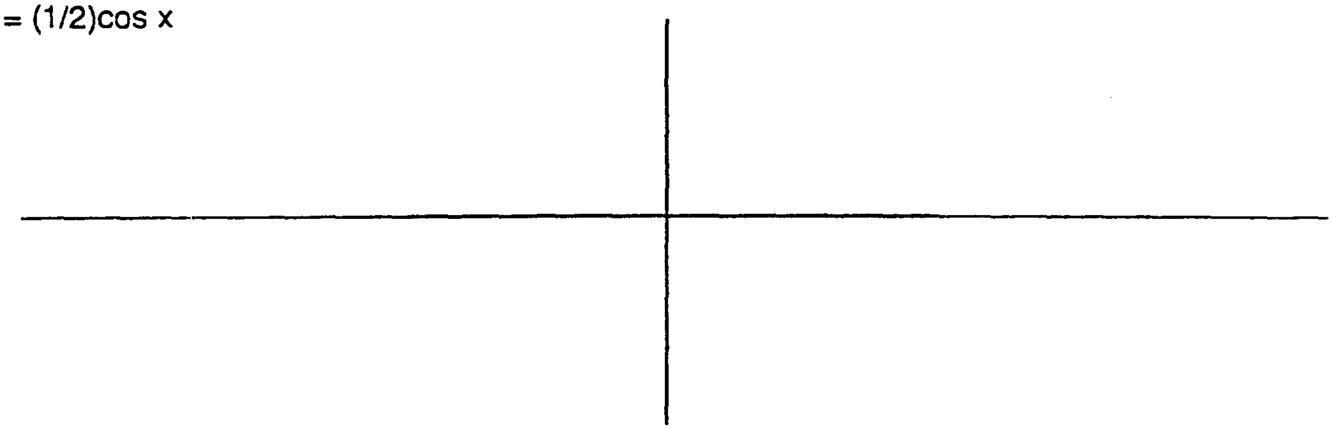
4. $y = 2 \cos \pi x$



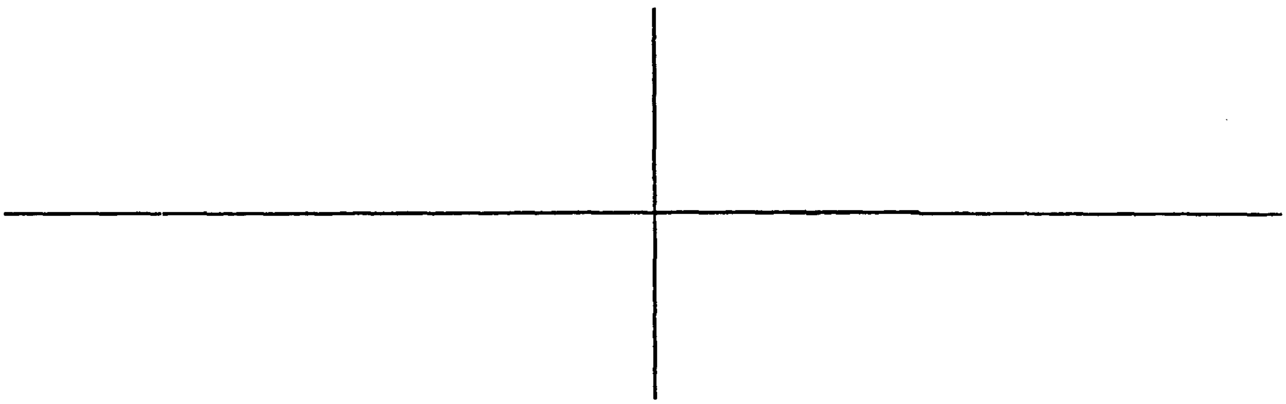
5. $y = \cos 2\pi x - 1$



6. $y = (1/2)\cos x$



7. $y = 3 + \cos 2x$



8. $y = \cos 4x$